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	PAGE		PAGE
Scientific Research and Industrial Development in Aid of Defence ..	117	Tetrazolium Bromide as a Valuable Tool in Microbiological Work—H. LAXMI-NARAYANA AND K. K. IYA ..	124
Tracer Technique in Agriculture ..	119	New Theory of Sunspots ..	125
Role of Dietary Factors in Experimental Liver Injury—P. K. VIJAYARAGHAVAN AND V. N. PATWARDHAN ..	120	Letters to the Editor ..	126
Symposium on Internal Combustion Engines ..	123	Reviews ..	142
		Science Notes and News ..	148

SCIENTIFIC RESEARCH AND INDUSTRIAL DEVELOPMENT IN AID OF DEFENCE*

IN recent years, the connection between defence and practical utilisation of resources, or in other words, industrial development, has come to be more and more intimately appreciated, and nations which are not in a position to meet some of their essential needs have harnessed science to make good the deficiencies by evolution of new processes, utilisation of new raw materials and development of substitutes. Classic examples of these are: fixation of nitrogen to produce ammonia and nitric acid, a process developed with the object of doing away with dependence on imported Chile salt-petre, production of sulphuric acid from gypsum in Germany during World War I, an instance of using new materials to meet defence requirements and the Fischer Tropsch's and Bergius' processes for production of synthetic petroleum products from coal.

Defence also aids science and industry by accelerating the pace of industrial development,

thereby providing new sinews for the progress of science and its application to useful ends. Rapid developments in the use of radar and sonar in many spheres like radio location, detection of hostile aircraft, guiding of bombers and bombing and location of submarines, have opened up innumerable possibilities for the application of these sciences in civil aviation, commercial navigation and several other similar fields. The availability of radio-active isotopes in relative abundance as a result of quick developments in the field of nuclear energy has provided new tools for scientific investigations in agriculture, industry and public health. The rapidity with which penicillin, streptomycin, aureomycin, atabrin, DDT and several other insect repellents and insecticides were developed and produced under the stress of war has been an invaluable contribution of defence in prevention and avoidance of disease.

In India also defence has been giving a fillip to science and industry. The tempo of industrial development was stepped up during the two world wars, and production of many new

* Summary of an Address to the Defence Science Conference in New Delhi, delivered by Dr. S. S. Bhatnagar, on 21st April 1952.

items was established mainly to meet defence demands and in some cases to meet shortages created by war conditions. One of the major contributions of World War II was the rationalisation of production in cotton, woollen and jute textiles. Leather and rubber are some other industries which benefited similarly. The emphasis on industrial products coming up to certain specified standards has to a certain extent been responsible for introducing standard methods of production and raising the quality of some Indian products to bring them on a par with imported material.

Besides, an analysis of the statistical data relating to education in scientific subjects shows that World War II inculcated an increased interest in science, and the number of students taking the I.Sc. and B.Sc. examinations began to show an appreciable increase from 1940-41 onwards. The establishment of a Board of Scientific and Industrial Research in 1940 and the Council of Scientific and Industrial Research in 1942 was primarily intended to utilise science in making India an efficient supply base. This is borne out by the resolution creating the Board in which emphasis was particularly laid on the development of industries whose importance or possibilities had been prominently brought to the forefront as a result of conditions created by the war. The expansion of these activities to cover the whole sphere of industrial development was a logical consequence of this step.

The scope of these influences has, however, been limited because of the nature of the 'basic' political set-up obtaining till recently. Major defence requirements were obtained from the U.K. and other foreign countries and only the barest minimum were met from indigenous resources. These conditions have been gradually changing and greater reliance on the ability of industrial concerns within the country to meet defence requirements is evident, but the lack of an organisation in the Ministry of Defence which could look at problems from a scientific point of view retarded the healthy development of these impacts. The setting up of the Defence Science Organisation three years ago is an indication of the change in outlook and now that this Organisation has established itself firmly, it should assume a more active and prominent role in effectively influencing progressive developments in certain specified fields of scientific research and industry.

In America the expenditure of the War and Navy Departments, excluding A.E.C., on research and development totalled 500 million

dollars in 1947. Of this only 20 per cent. was spent in Governmental laboratories while 80 per cent. took the form of contracts with industrial and university laboratories. Not all this money was for applied research only; a portion, though a small one, of 35 million dollars also went to promote basic research. These figures are just illustrative of the extent to which defence organisations in the U.S.A. support research in Universities and other industrial laboratories. While it is not suggested that the Defence Science Organisation in India should at the very start begin supporting educational and research institutions on the same scale, a beginning in placing of research contracts with various research organisations is immediately called for. Besides promoting science in general, such a step will also assist in training of technical personnel in specialised fields to meet defence requirements.

In this respect the various National Laboratories of the Council of Scientific and Industrial Research offer a unique opportunity for active collaboration. For instance, the Central Food Technological Research Institute, Mysore, could take up investigation on canned rations of various types and their behaviour on storage under different conditions. It has already developed a canned vegetable curry which is highly nutritious and will, I am sure, be appreciated by the armed forces. Similar collaboration in ultrasonics and electronics particularly with the National Physical Laboratory can lead to very useful results. India has a long coast-line extending over nearly 2,500 miles, yet no detailed coastal map of India has so far been prepared. One of the major undertakings awaiting the Defence Science Organisation is a regular survey of the coastline and the surrounding seas and in the execution of this project, ultrasonics can play a major role.

Extension in practical applications of electronics is also possible in various fields and by subsidising research in this subject, defence will be laying the foundations for the establishment of an electronics industry within the country.

The same applies to other National Laboratories. The National Chemical Laboratory could, for instance, assist in evolution of simple devices for desalting of water. It could also undertake on behalf of defence basic studies of new explosives. The Fuel Research Institute could help in the study of improved methods of coking and carbonisation to obtain better yields of benzene, toluene, phenol and other similar essential chemicals. It should

also be possible to consider jointly how far establishment of petrochemical industries in meeting some of these requirements is feasible.

In the field of industry also, there are several items which defence should either take up on its own or subsidise directly with a view to establishment of industrial production of some essential raw materials. The priorities which defence requirements command carry the added advantage of ruling out ordinary economic considerations. In many cases establishment of indigenous production is essential although it is obvious that to start with, costs will be higher, appreciably higher, in many cases. An example that readily comes to mind is that of phosphorus, initiation of manufacture of which under present conditions would be uneconomic without direct support from defence.

Besides engineering industries, the ordnance factories of defence include a number of chemical industries which have now been running for a long period. In this connection, reference may be made to the manufacture of acetone from alcohol and oxidation of ammonia to produce nitric acid. The affairs of these factories are at present defence secrets, but I do believe that a stage has now been reached when it should be possible to reveal the economics of manufacture so that the experience gained may prove useful in arranging production of these materials for ordinary industrial purposes.

Subjects which will receive prominent attention during this week's conference are ballis-

tics, operational research, personnel research and environmental physiology. I am glad a whole afternoon is being devoted to the study of 'Ballistics in Universities' and I have every hope that in the contributions to the discussion, the significant need of support, both moral and material, to the development of this subject in the Universities will be fully brought out. The same remarks apply more or less to the other subjects, operational and personnel research.

As one of the largest employers in the country the defence organisation has indeed a unique opportunity of making substantial contributions to promoting the general welfare of the nation. Armed forces have under constant study various problems connected with the welfare of their personnel such as checking and avoidance of various diseases, causes of nutritional deficiency and ways and means of making these good, etc. These studies are at present restricted to particular areas and conditions obtaining in defence establishments and camps. Provision of facilities to State and social workers in extending these investigations and preventive measures to other areas in collaboration with defence personnel offer a unique opportunity for collaboration with defence in making effective contributions in promotion of general national welfare. This association cannot fail to have far-reaching educative effects on the masses of India and will doubtless serve to raise their general standard of living substantially.

TRACER TECHNIQUE IN AGRICULTURE

WITH the aid of radio-isotopes it has become possible to trace nutrients through the soil, into roots, and thence through plants, to measure the extent and speed of their movement; to determine at what stage in its growing cycle the plant needs fertilizer most; to know where and how fertilizer should be placed to give the plants the maximum benefit; to establish what kinds of fertilizers work best in the country's varied soils; and to answer other practical questions about the techniques of fertilizer use. Such probing is rather necessary as experiments made during the past few years have shown that crops differ widely in their abilities to use natural phosphorus from the soil or from commercial fertilizers. Also, tests made on many crop plants seem to emphasise that the beneficial effect of fertilizers depends greatly on the form of phosphate used, when it is applied, and where in relation to the seeds.

Other work with radio-isotopes relates to the biological sources of plant nutrients with a

view to study the mechanism whereby plants receive nourishment from organic matter in the soil and the way in which bacteria on the roots of bean plants build up the nitrate content of the soil to nourish future generations of growing plants. Still further research is being done on the nutritional diseases of plants and sickness of trees.

Crop pests do damage to the extent of 6 billion dollars a year in the U.S.A. alone. By building radio-active isotopes into the chemical structures of pest-killing preparations, researchers gain clearer knowledge of their basic action, their advantages and limitations. Radio isotopes are peculiarly useful in this field because insecticides and weed killers are ordinarily used at such low concentration that detecting them by other means is difficult or impossible. As tags on food given to air-borne fungi and insects, isotopes are used to 'label' these species and map their patterns of dispersion.

ROLE OF DIETARY FACTORS IN EXPERIMENTAL LIVER INJURY

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LIVER cirrhosis is of frequent occurrence among poorer classes of Indians, but its aetiology remains rather obscure. Accumulated data from clinical findings indicate that dietary deficiency may be an important aetiological factor and that alcohol which is believed to be a contributing agent in the production of this disease among European populations cannot be implicated as a cause among Indians.¹⁻³ Definite evidence regarding the role of various dietary factors in the production and prevention of different types of liver injury has been forthcoming from experiments with animals. The relation between diet and hepatic damage has only recently received the attention it deserves. It was Weichselbaum in 1935⁴ who first demonstrated that individual dietary factors alone can cause injury of the liver in rats. He noticed that deficiency of sulphur containing amino-acids caused death with 'hæmorrhage' of the liver. Since then greater attention is being paid to trace the defects in the diet which are ultimately responsible for portal cirrhosis in human beings.

The volume of experimental work on the production of different types of liver lesions accumulated during the last ten years is considerable and it becomes somewhat difficult to classify systematically all the types of liver damage produced by dietary means by various workers. Fatty infiltration followed by diffuse hepatic fibrosis produced in animals by diets rich in fat, low in lipotropic factors forms one kind. Hershey and Soskin's⁵ preliminary experiments on the use of lecithin to cure fatty livers produced in depancreatized dogs stimulated Best and co-workers⁶⁻¹⁰ in their identification of choline, a constituent of phospholipids, as an important lipotropic factor. The lipotropic activity of casein and other proteins is attributed to the presence of methionine contained in them.¹¹⁻¹⁴ By the use of methionine labelled with radio-active carbon as well as deuterium and N¹⁵, du Vigneaud and associates^{15,16} established that the lipotropic activity of methionine was due to its 'labile' methyl group which is utilised for the synthesis of choline. Accumulation of abnormal amounts of fat in the liver resulting from ingestion of high fat in the diet or from a deficiency of lipotropic factors in the diet or from both causes seems to lead towards structural changes of

liver cells such as fatty infiltration leading on to cirrhosis. Chaikoff, et al.,¹⁷ always noted high hepatic fat preceding liver damage that occurred in completely depancreatized dogs. Cirrhosis of the liver has invariably been produced in rats by feeding diets containing over 50 per cent. of fat.¹⁸⁻²⁵ The lesions were, however, prevented by increasing the contents of choline or methionine in the diet and a reduction in the fat content accelerated the beneficial effects of the lipotropic factors. It is thus seen that the liver lesions of animals of all these workers were always preceded by various degrees of fatty infiltration which was followed by fibrosis.

The second type of hepatic lesions produced in animals is characterised by necrosis and post-necrotic fibrosis resulting from a diet low in protein, fat and lipotropic factors. The condition is described as massive or acute necrosis with or without hæmorrhage. This type of liver injury has been successfully produced in rats by Himsworth and Glynn²⁶⁻²⁸ by a protein-deficient diet. The necrosis produced, according to the authors, resembled acute yellow atrophy in man and progressed "to a condition of scarring similar to nodular hyperplasia". Cystine was found to have protective action against this type of massive necrosis.²⁹ The ingestion of methionine in a dose of 20 mg. per rat per day was completely protective. The protective action of methionine may probably be due to its breakdown to homocystine after demethylation, the liberated homocystine being the source of cystine. The above authors claimed to have produced two distinct types of liver lesions, viz., diffuse hepatic fibrosis and massive necrosis by suitable choice of deficient diets.³⁰ The former type of lesions was produced by a high fat diet with low choline and methionine while the latter was produced by a low fat low protein diet. However, the type of lesions produced by other authors with similar diets have always been mixed. Gillman and co-workers³⁰⁻³² found that the diet of South African natives which consisted of mealie pap (maize meal porridge) supplemented frequently by fermented cow's milk was capable of producing severe liver damage in rats. The injury of the liver usually expressed itself as diffuse fatty liver, cirrhosis, lobar absorption or diffuse lobar enlargement. Wahi³³ fed rats with

a synthetic high carbohydrate low protein diet, which was claimed by the author to resemble the deficient diet of vegetarian Hindus among whom many cases of cirrhosis are believed to occur, and found that their livers showed varieties of lesions like focal or diffuse necrosis, fatty infiltration and incipient cirrhosis. He also noticed that the type of liver damage was determined by the age of the animal. Similarly, Abell, Beveridge and Fisher³⁴ induced hepatic necrosis in rats by feeding them a diet low in protein. During the preneurotic period the livers showed significant loss of cytoplasm; the biochemical changes observed were, fall in liver weight and progressive increase in liver lipids.

The sulphur containing amino acids methionine and cystine, are now known to be particularly concerned in the maintenance of the integrity of liver cells. The importance of methionine as a lipotropic agent and as a curative agent against massive necrosis has already been indicated. Dietary cystine is known to exert three effects: (a) Complete lack of this amino-acid in the diet leads to massive necrosis.²⁹ (b) If the dietary methionine is suboptimal, cystine may exert an alipotropic action.^{35,36} Two views regarding the alipotropic action of cystine are put forward. The first postulates antagonistic action of cystine against the lipotropic action of methionine and according to it the extent of injury depends on the ratio between them. The second ascribes the unfavourable action of excess of cystine to its power of promoting growth when supply of dietary methionine is suboptimal. (c) Large doses of cystine produce haemorrhagic necrosis of the liver.³⁷⁻³⁸ Methionine appears to be the key substance involved in liver disease and promises to be important because of having both the 'labile' methyl group as well as the sulphydryl group which are known to play important parts in protecting liver cells.^{39,40,41} Methionine has been known to lessen the damage to liver or improve the chances of recovery from toxic chemical agents such as chloroform,⁴² carbon tetrachloride⁴³ and pyridine.⁴⁴

The relationship between the deficiency of vitamins and hepatic injury was noticed by Patek⁴⁵ and Patek and Post⁴⁶ who obtained favourable results in the treatment of hepatic cirrhosis in humans by 'high vitamin therapy' particularly with B complex vitamins. The influence of individual vitamins of the B group on liver injury was studied by various workers. Thiamine, riboflavin, pyridoxine and nicotinic

acid were not found to have any beneficial effects on Laennec's type of cirrhosis produced in rabbits by Rich and Hamilton.⁴⁷ Thiamine⁴⁸ and biotin⁴⁹ were found to favour the deposition of fat in the liver; choline was curative against thiamine induced fatty liver while biotin fatty liver was prevented by inositol. Chronic vitamin A deficiency in rats was not found to produce any type of lesions described above.⁵⁰ The sparing action exerted by vitamin E on sulphur containing amino-acids in the prevention of massive necrosis has been definitely claimed by Himsforth and Linden⁵¹ and Gyorgy and Goldblatt.⁵² These results were in confirmation of the earlier findings of Schwartz⁵³ and Gyorgy.⁵⁴ The results of Schaefer, Salmon and Strength⁵⁵ on the interrelationship of vitamin B₁₂ to choline indicated the probable lipotropic activity of this most recently isolated vitamin. Vitamin B₁₂ was also found to exert a methionine sparing action in pigs, chicks and rats fed a methionine-deficient diet.⁵⁶⁻⁵⁹ Popper, *et al.*⁶⁰ and Koch-Weser, *et al.*⁶¹ found that administration of vitamin B₁₂ to rats preceding acute carbon tetrachloride intoxication inhibited the development of histological changes of the liver while Gyorgy and Rose⁶² reported that vitamin B₁₂ exhibited marked lipotropic activity in rats maintained on a low protein, low fat ration, but had no effect on the development of massive necrosis. It is of interest to find that preliminary studies made on the effect of vitamin B₁₂ in infantile cirrhosis have shown beneficial effects attributable to the vitamin.^{63,64}

Among the antibiotics aureomycin was found by Gyorgy⁶⁵ to have protective effect on massive necrosis.

Literature surveyed so far establishes beyond doubt the role of various dietary factors in the production and prevention of different types of hepatic injury. The importance of choline and methionine and to a lesser extent that of vitamin E and vitamin B₁₂ can very well be recognised. Animal experiments designed to produce liver damage by dietary means have mostly been conducted with synthetic diets which were highly purified and consequently different from the natural diets of communities in which cirrhosis of the liver is fairly common. In actual practice it happens that the various factors whose deficiency leads to one or the other type of liver injury reported tend to occur together thus complicating the picture. In considering liver injury in human beings there is no justification for the assumption that the effect of a natural diet containing various

factors in varying amounts will be same as that of a pure synthetic diet whose composition is definite and well known. This consideration makes it important to study the influence on the liver of natural deficient diets consumed regularly by populations among whom there is a high incidence of liver disease. Vijayaraghavan and Patwardhan⁶⁰ conducted experiments to examine the possibility of producing liver injury in rats by feeding a typically deficient poor rice diet. With such a diet early degenerative changes and marked refraction of the cytoplasm of parenchymal cells were seen after 15 and 21 months of experimental duration.

The results obtained from animal experiments do indicate, therefore, to some extent the probable aetiology of liver diseases among human beings who are consuming deficient diets. Though it is difficult to assume that the results from these experiments are fully applicable to humans, yet there is some justification for believing that the liver damage in man may also be determined by some of the factors responsible for liver injury in experimental animals when it is realised that the deficiencies in the human diets are almost the same.

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SYMPOSIUM ON INTERNAL COMBUSTION ENGINES

A Symposium on Internal Combustion Engines was held in the premises of the Indian Institute of Science, Bangalore, under the joint auspices of the C.S.I.R. and the Indian Institute of Science on the 5th and 6th of April 1952. The occasion was well attended and representatives of various Departments of the Government of India, the National Laboratories, the I.C.E. Industry, Oil Companies and Universities participated in the activities.

The inaugural session was held under the Chairmanship of Dr. J. C. Ghosh, who presented a brief review of the position of the I. C. Industry in the country and the various activities of the Council of Scientific and Industrial Research, at the Indian Institute of Science, Bengal Engineering College and other Industrial firms that were working towards the progress of the Industry. Dr. H. A. Havemann explained the details of the Gas Turbine test house, diesel and aero engine developments and other work carried out in the Internal Combustion Engineering Laboratory. Dr. S. R. Sen Gupta gave a brief account of the research work on Gas Turbine conducted at the Bengal Engineering College, Sibpur. Prof. M. S. Thacker gave an outline of what assistance the various Departments in the Institute were giving and would continue to give, towards the furtherance of research for and progress of the I. C. Industry.

The delegates were then taken round the Internal Combustion Engineering Laboratory and shown various items of research work under progress. U-type two-stroke Diesel engines, Low Pressure Fuel Injection in Diesel Engines, Aero engine with Fuel Injection for Aircraft Propulsion, Cyclone Gas Producers, Injection Device for Pulverised Fuel, Test-rig for Derwent V Aero-gas Turbine, Test-rig for Gas Turbine Combustion Chambers, High Speed Diesel Engines running on heavy fuels, Hot Air Engine, were some among the special exhibits.

Items of research in progress related to: Effects of Turbulence on Combustion, Heat Transfer in Oscillating Gases, Cyclone Air Filtration. The morning session came to a

close after a demonstration run of the turbojet engine in the Internal Combustion Engineering Laboratory.

The afternoon session held under the Chairmanship of Dr. S. R. Sen Gupta was devoted entirely to a discussion of the "Design Trends in I.C. Engines". 12 Papers were presented, dealing with petrol engines for road transport, automotive engines running on producer gas, a new hot air engine, low pressure injection for Diesel engines, scavenging of two-stroke Diesel engines, experimental aero-engine, testing of gas turbines, progress of Diesel engine manufacture in the country, etc.

The morning session on the 6th was presided over by Dr. J. W. Whitaker to discuss "Fuel and Combustion Problems". 12 Papers were presented dealing with the production of power alcohol, use of heavier fuels in Diesel engines, cyclone gas producer, indigenous fuels for I.C. Engines, some aspects of combustion in I.C. Engines, injection of pulverised fuel into pressurised chambers, standardised tests for lubricants, etc.

During the afternoon session, presided over by Prof. M. S. Thacker, a number of papers were presented dealing with the Production, Materials and Component Manufacture. Papers were read on spheroidal graphite, cast iron and meehanite in I.C. Industry, high duty materials for engine components, air-cleaners, gears, mechanical wear, etc.

The last part of the afternoon session was devoted to the discussion of technical aid to industry by research organisations. The discussion was very lively, and representatives of manufacturers, heads of research organisations and university professors took part. As a result of these discussions it was possible to define what industry expects from technical institutions and in turn, what help the technical institutions require from industry to carry out the suggestions made by representatives from industry.

Fuller details of the proceedings will be published in book form by the Council of Scientific and Industrial Research in due course.

TETRAZOLIUM BROMIDE AS A VALUABLE TOOL IN MICROBIOLOGICAL WORK

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IN the course of our studies on the reducing activities of bacteria of dairy importance, 2:3:5 triphenyl tetrazolium bromide* was found to be a very useful oxidation/reduction indicator with a variety of possible applications in microbiological research. The use of tetrazolium salts has been reported previously in connection with the testing of seed viability,^{1,2} for the colorimetric estimation of reducing sugars and other reducing substances,^{3,4} for vital staining⁵ and for the *in vitro* studies of certain dehydrogenase activities.⁶ However, its use in microbiological work has not received much attention.

Triphenyl tetrazolium bromide is soluble in water and forms a colourless solution, but in its reduced state (formazon) the indicator assumes an intense cherry red colour and is also insoluble in water. Formazon is, however, soluble in benzene, pyridine, glacial acetic acid, oleic acid, chloroform, butyl alcohol, propyl alcohol and other organic solvents. Its E_0 has been reported to be 0.08 volts.⁷ The reducing substances present in raw and heated milks and in autoclaved bacteriological media have no effect on this indicator (unlike methylene blue or resazurin) except under strongly alkaline conditions and at high temperatures. Any appreciable reduction of the indicator in culture media may, therefore, be ascribed to the reducing systems of bacteria during their growth and metabolic activities. The red dye can be extracted with a suitable solvent and measured quantitatively in a photo-electric colorimeter.

While studying the reducing activities of various organisms in milk and other media using tetrazolium bromide as an O/R indicator it was observed that the visible production of the red compound "formazon" started just after methylene blue and resazurin were completely reduced to their leucobases under comparable conditions (E_h of medium -0.05 to +0.20 V.) and the colour became intense at a stage corresponding to the complete decolourisation of Janus Green B (E_h of medium -0.20 to -0.15 V.). Preliminary work suggests that the reduction of the dye takes place mostly within the cell and partly on the cell surface and in the former case the red dye may diffuse into the medium along with organic solvents either

in the normal course or as a result of the autolysis of some of the cells. The cell-free filtrate was not found to be capable of reducing the indicator. Like other dyes, tetrazolium (in concentrations of 0.1 per cent. and higher) was also found to exert some influence on the growth and acid production of the organisms in the early logarithmic stage of growth. The extent of inhibition or stimulation depends on the species and numbers of organisms as well as on the nature of the medium. The possibilities of using this indicator for the following aspects of microbiological research have been studied.

(i) *Taxonomical studies.*—Different species of bacteria showed significant differences in the rates of reduction of tetrazolium. The dye was found to be reduced most markedly by the lactic acid bacteria as a group but there was considerable variation from species to species within the same genus. For example, *Streptococcus liquefaciens* and *S. faecalis* were the most powerful reducers while the heterofermentative streptococci showed the least reducing effect. Among the lactobacilli, *Lactobacillus lactis* and *L. bulgaricus* reduced the dye more strongly than other species. In the case of some species the red compound appeared to undergo further changes in colour on prolonged incubation of the culture. This differential behaviour of the organisms would appear to be helpful in their taxonomic classification and in the study of their metabolic activities. Sugar fermentation reactions and other biochemical tests commonly employed in classifying bacteria can be followed rapidly by observing the reduction of tetrazolium by the organisms in different media.

(ii) *Nutritional requirements of bacteria.*—The reduction of the indicator by growing cultures of bacteria was considerably influenced by the nutritional adequacy of the medium apart from the effect of cell population. By growing the organisms, in the presence or absence of various nutritional factors and then quantitatively measuring the reduced dye it has been possible to determine the specific nutritional requirements of different organisms within a short period of 6 to 8 hours. In the case of certain species, significant differences between their dye reducing capacities and their growth and acid production were also observed.

* Trade name: Grodex—May and Baker product.

(iii) *Microbiological assay of vitamins, amino acids, etc.*—An interesting application of the relation between the nutritional requirements of the organisms and their dye reducing abilities has been found in the use of this indicator for microbiological assay of riboflavin. An external source of riboflavin was found to be essential for the reduction of tetrazolium by *Lactobacillus plantarum*-89, *Streptococcus faecalis*-190 and a few other organisms. The response of the test organism to graded doses of pure riboflavin was assessed in terms of the amount of formazan (intensity of red colour of the butanol extract) produced in the medium in about 6 to 8 hours and was found to be linear, like the response measured on the basis of acid production after 48 or 72 hours. The method has given encouraging results for the microbiological assay of riboflavin in milk. It is suggested that this principle of measuring the reducing activities of organisms as a basis for the assay of other vitamins, amino acids and other factors offers great possibilities.

(iv) *Quality control of milk.*—Dye reduction tests using methylene blue and resazurin have been widely employed in the quality control of milk. Tetrazolium, which does not impart any colour to milk initially, gradually colours it red as a result of its reduction to formazan by bacterial activity. It was found that poor quality milks with high bacterial numbers (plate counts over one to 10 million cells per ml.) became intensely red in 3 to 4 hours. The extent of reduction could be measured and standardised against suitable gradations of colour prepared by adding safranin and methyl orange to sterile milk. Although this indicator is not likely to be of much use for the rapid platform testing of milk, it appears to be par-

ticularly useful in quality improvement programmes for dramatically demonstrating to the producers the poor quality of milk and the need to improve their methods.

(v) *Other applications.*—The indicator is basic in character and can be used as a vital stain. In growing cultures of organisms like *Lactobacillus bulgaricus* in a medium containing the indicator, the metachromatic granules are stained intensely red. This also indicates the possibility of the use of tetrazolium for the quantitative determination of nuclear materials in the cell.

It was also observed that the addition of a small amount of the indicator (in non-toxic concentrations) to the agar medium resulted in the development of red pigmented colonies against a colourless background, thus making the enumeration of colonies easier. This method has been found particularly useful in counting cells by the 'Frost Little Plate' method since the small colonies developed in 4 to 6 hours are intensely red coloured and can be easily counted under the microscope.

Detailed results on some of the aspects referred to in the note will be published elsewhere.

We are grateful to Dr. K. C. Sen, Director of Dairy Research, for his keen interest in the work.

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NEW THEORY OF SUNSPOTS

DR. S. CHANDRASEKHAR, Professor of Theoretical Astrophysics at the University of Chicago's Yerkes Observatory, was awarded the Bruce Medal, top American honour in Astronomy, presented annually by the Astronomical Society of the Pacific. Accepting the Medal, Prof. Chandrasekhar presented for the first time his new theory of the origin of sunspots.

The gist of the theory is that strong magnetic fields inhibit the movement of fluids by convection. Normally, convection currents are present in the body of the sun, whereby hot gas form far down moves up to the surface, gets cooled and then turns down again. This

constant upwelling of hotter gas from below keeps the sun's surface bright. According to Prof. Chandrasekhar, strong magnetic fields on the sun's surface create a force which prevents the upwelling of the gas beneath the field. Since hot gas cannot come up to replace the cooled gas at the surface, the gas swirls around and cools off further, thus reducing its brightness and leading to the presence of dark sunspots.

The new theory is likely to offer a means of improving weather forecasting and lead to a better understanding of movements in the earth's atmosphere and of the gases within the sun and other stars.

LETTERS TO THE EDITOR

	PAGE		PAGE
Plastic Deformation in Beams—Y. V. G. ACHARYA AND G. JANAKI RAM ..	126	Intestinal Thiamine Synthesis as Influenced by Dietary Levels of Protein—S. BALAKRISHNAN AND R. RAJAGOPALAN ..	134
Dilatation of Electrolytic Copper Powder Compacts—A. GUPTA ..	127	Influence of Dietary Supplementation of Milk and Curd on the Intestinal Synthesis of Thiamine in Rats—S. BALAKRISHNAN AND R. RAJAGOPALAN ..	135
Manganiferous Micas of India—L. L. FERMOR ..	128	Leaf Shape Expression in New World Cotton Hybrids between Wild Diploids and Cultivated Tetraploids—R. BALASUBRAMANIAN ..	136
Occurrence of Ginkgoales in the Rajmahal Series of Behar—SATISH CHANDRA DAS SAH ..	129	Stability of Vitamin C in Neera from Date Palm at 37° C.—M. N. GUTTIKAR AND KAMALA SOHONIE ..	137
Use of Light of Different Intensity and Colour in Luring Fish—C. V. KURIEN, V. K. PILLAI AND G. S. NAIR ..	130	Paddy-cum-Fish Culture in Relation to Public Health—S. L. HORA ..	136
The General Properties of Iron Oxide Sol—A. K. M. TRIVEDI AND A. S. DIVATIA ..	131	Prolonged Larval Period and Delayed Emergence of Adults in Procontarinia matteiana Kieff. & Cecc. (Itionididae: Diptera)—R. L. GUPTA ..	139
Study of a Group of Synthetic 3-Methyl Iso-quinolines for Their Spasmolytic Properties—V. ISWARIAH AND V. S. VENKATA SUBBU ..	131	Circumscissile Dehiscence in Sphenoclea zeylanica Gaertn.—K. SUBRAMANYAM AND M. V. S. RAJU ..	139
Circular Paper Chromatographic Analysis of the Amino Acids of Tea and Coffee Infusion—K. KRISHNAMURTHY, T. A. VENKITASUBRAMANIAM AND K. V. GIRI ..	133	Abnormal Leaves of Cycas revoluta Thunb.—RAMESH KUMAR SRIVASTAVA ..	140
Deamination of Amino Acids by Vibrio cholerae—A. DUDANI, S. N. IYER, C. R. KRISHNA MURTI AND D. L. SHRIVASTAVA	134		

PLASTIC DEFORMATION IN BEAMS*

THE plastic behaviour of a material loaded beyond yield may be compared to that of a highly viscous fluid. For equal deformations in the plastic and elastic states, the stress for plastic deformation is much less than that for the elastic state, with the result that the sustained stress in the former state tends to fall. This gives rise to the upper and the lower yield points. In the stress-strain diagram these two points are clearly marked for structural steels, whereas in ductile materials the difference between them is not so marked. The corresponding stresses, i.e., the upper and the lower yield stresses, the difference between which may be as high as 25% of the higher stress, are very important and introduce many complications in the theory of plasticity.

If it is considered that the change from the elastic to the plastic region in a material which

is in an elasto-plastic state of stress occurs over a layer which is very thin, then the gradient of the stress and hence the instability in this layer would be large. If this layer has a finite thickness, then the stress gradient and consequently the instability would be small. In any case this layer appears to spread fast initially and then slowly till the whole material goes into a plastic state. Hence the criterion for determining the working stresses in a material is the lower yield stress rather than the upper yield stress. This elasto-plastic region has its analogues in hydrodynamics, the methods of which may be applied here also.

If this layer is sufficiently thin to be considered infinitesimal, it may be treated as a shock. If it has an appreciable thickness, it may be considered analogous to a boundary layer which is a region of distributed vorticity and can be laminar or turbulent, and which

may "separate" or generate secondary flow. These concepts may be used in an investigation of the elasto-plastic flow.

If the elasto-plastic interface is treated as a shock, then the normal stress components f_{11} and f_{22} parallel to the interface need not be equal, though the other normal stress components and the shear stress on either side of the interface are equal and continuous. The jump in f_1 is given by Prager¹ as:

$$f_{12} - f_{11} = \pm (4k^2 - \tau^2),$$

where k = maximum shear stress at yield point and τ = shear stress on either side of discontinuity surface.

From an engineering point of view, the moments of rectangular beams under pure bending have been calculated for the following cases:

(a) Within the yield point, (b) above the yield point beyond some point P for structural steels where the stress falls to the lower yield and (c) above the yield point as before for ductile materials where the stress is sustained at the upper yield (see Figs. 1 a, b and c).

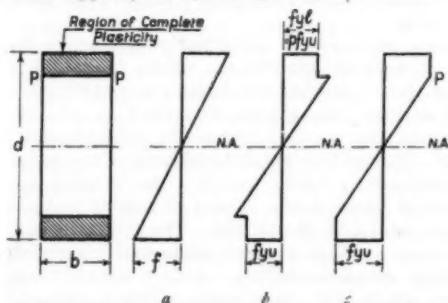


FIG. 1. Idealized stress diagrams for: (a) Elastic bending. (b) Plastic bending of structural steels. (c) Plastic bending of ductile materials.

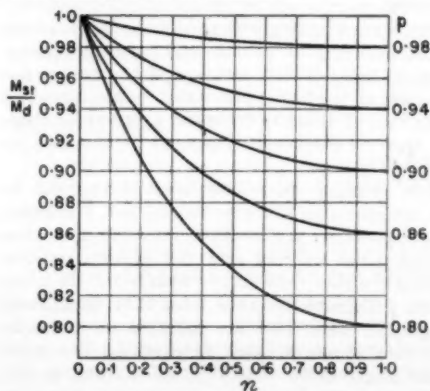


FIG. 2. Ratio of Plastic moment in structural steels to elastic moment.

$$(a) M_e = \frac{f_{ys} b d^3}{6}$$

$$(b) M_{st} = \frac{f_{ys} b d^3}{12} \{p [3 - (3-2/p)(1-n)^2]\}$$

$$(c) M_d = \frac{f_{ys} b d^3}{12} [3 - (1-n)^2]$$

where n is the fraction of semi-depth gone into the plastic state.

The curve showing the variation of the ratios of the two last moments with increasing depth of the plastic region is given in Fig. 2, for various values of p as parameter. It is seen that the percentage reduction in plastic moment reaches asymptotically the percentage drop in yield stress, as plastification spreads to the neutral axis. It is, therefore, evident that the effect of lower yield cannot be ignored.

Ind. Inst. of Science, Y. V. G. ACHARYA,
Bangalore, G. JANAKI RAM.
March 21, 1952.

* Original paper presented at the Technical Session of the Aeronautical Society of India, in March 1952.

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DILATATION OF ELECTROLYTIC COPPER POWDER COMPACTS

THE nature of dilatation curves obtained with "fine" copper powders has been described by Tzrabiatowsky,¹ who does not mention the details of fabricating the compacts. The author has corroborated Tzrabiatowsky's work while studying the nature of sintering of electrolytic copper powder compacts.²⁻³ It is intended here to put briefly on record the dilatation curves of compacts made from electrolytic copper of different particle sizes, viz., (-40 + 100), (-100 + 200), (-200 + 300) and (-325) mesh, briquetted at 25 tons per square inch. For ease of reference, the particle sizes are respectively mentioned below as A, B, C & F.

The powder compacts made in the manner described by Gupta⁴ were heated in a stream of pure hydrogen in a dilatometer shown in Fig. 1. The instrument was calibrated using

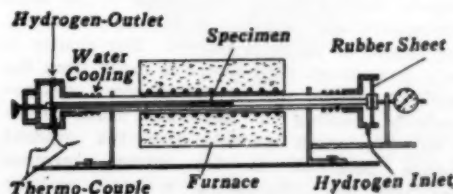


FIG. 1

austenitic steel (18/8 Ni-Cr) of known thermal expansion. The dilatometric curves obtained with 3.0 inches long specimens are shown in Fig. 2 where the dial reading (inches) of the

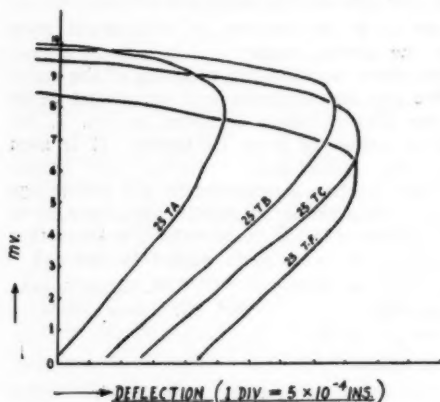


FIG. 2

Mercer gauge is plotted against the voltage (m.v.) of the thermo-couple (Pt-10% Pt/Rh). The latter was inserted within an 1/8th inch diameter 1/4 inch deep hole at one end of each specimen. The changes in length have been noted against every 0.1 m.v. rise. The observed points were therefore so close that they have not been shown in the curves. In the figure, the origin for each curve has been progressively shifted to the right to avoid overlapping.

The general trend of the curves is the same, i.e., increase in length with temperature followed by a rapid decrease. The temperature at which rapid contraction occurs depends upon the particle size; thus the smaller the particle size the lower is the temperature at which expansion ceases and contraction commences. Further the smaller the particle size the greater is the extent of contraction. The nature of the curves remained unchanged *in vacuo*, nitrogen and carbon dioxide atmospheres.

If a specimen once heated in hydrogen is allowed to cool in the dilatometer in the same atmosphere and reheated in the same manner, the nature of curve is altered. The change is very pronounced with compacts made from the smallest particle size of the powder. On repeatedly heating a specimen made from -40 + 100 mesh particle size the gradual change observed in the curves becomes less and less. Calculating α in a manner similar to Tzabiatowsky, from the straight

portion of the curve obtained after the 5th heating of the same specimen (particle size A), the value obtained was 18.68×10^{-6} cm./° C.

The above work was carried out at Hadfield Research Laboratory, The University, Sheffield. The author is indebted to D.S.I.R., London, for the grant in aid.

Development Research Lab., A. GUPTA.
The Assam Oil Company, Ltd.,
Digboi, Assam,
March 4, 1952.

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MANGANIFEROUS MICAS OF INDIA

I HAVE read with interest the letter dated October 20th, 1951, on page 43 of Volume 21 of your Journal.¹

As a result I have consulted what I wrote on the Indian manganiferous micas in 1909.² I find that I divided the Indian manganiferous micas into two groups according to colour, placing the brown micas under manganophyllite, (?) and the crimson and pink micas under alurgite (?). These question marks were appended because the Indian examples had not been analysed chemically. The "rich brown, bronze, or deep orange" micas that I grouped under manganophyllite, with a query mark (*loc. cit.*, p. 196), were some of them uniaxial and some of them biaxial, as is the case with biotite, with which Dana groups manganophyllite.

The term *alurgite* was applied by me to micas of crimson or pink colour, and I was encouraged to do this not only because of the colour but because of the high optic axial angle agreeing with that of alurgite from the original locality, St. Marcel, Piedmont, Italy, as determined by Penfield.

The reasons why the mica noticed by Mr. Bilgrami as alurgite should not, I suggest, be so described are twofold: the colour as described is not correct and the mineral as described is either uniaxial or nearly so. It is fair to Mr. Bilgrami to note here that Breithaupt originally described the mineral as uniaxial, but that Penfield later determined the optic axial angle as $56^{\circ}5'$ to 57° . (See Dana, p. 635, and Appendix I).

The most interesting association of these Indian manganiferous micas noticed by me occurred at the Sitapathur manganese mine in the same district (Bhandara) as Sitasonggi. The association was in a rock composed largely of a rose-red mica (alurgite?) with a bronze mica (manganophyllite) with also scattered grains of a black manganese-ore.

The optic axial angles of alurgite and manganophyllite as given by Dana were: Alurgite, 56° - 57° ; Manganophyllite—not given, but that of biotite under which this mica is grouped by Dana is usually sensibly uniaxial, though the optic axial angle of biotite is occasionally as high as 50° .

Both of Mr. Bilgrami's micas from Sitasonggi, judging from his description, would have been grouped provisionally by me under my manganophyllite (?), though, as I then noted, there must be at least two species amongst the Indian brown, bronze and deep orange micas. There may also be more than one mica sheltering under my alurgite (?).

It was for the benefit of, and to encourage future research that I recorded the incomplete data given in my memoir on "The Manganese Deposits of India". I do not think that much progress will be made in the determination of our Indian manganiferous micas until some one finds the time to make a complete optical and chemical study. Optical work alone is not enough. The best material upon which to commence work would be the rock from Sitapathur with its association of crimson-pink and orange-brown micas (loc. cit., p. 740). At present all we can say is that the pink manganiferous micas are probably more closely allied to the muscovite group and have large optic axial angles; and that the bronze or brown micas belong to the biotite group and have optic axial angles varying from nil to an occasional high figure.

24, Durdham Park,
Bristol 6,
March 29, 1952.

L. L. FERMOR.

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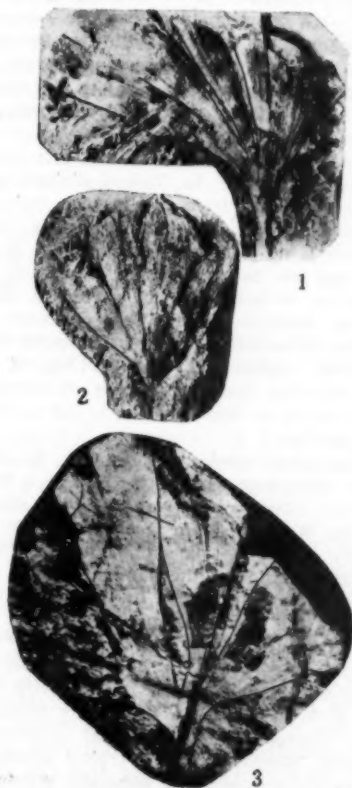
OCCURRENCE OF GINKGOALES IN THE RAJMAHAL SERIES OF BEHAR

THE only Mesozoic Ginkgoales known so far from India are those described by Feistmantel from the Upper Gondwanas of the Jabalpur group and the Sripermatatur area of Madras by Seward and Sahni.¹ There are two species based on leaf impressions: *Ginkgo(ites) lobata*

Fstm. from Sher river in the Satpura basin² and *G. crassipes* Fstm. from Sripermatatur beds.³ A few detached linear leaves from Sher river have been doubtfully referred by Seward and Sahni (loc. cit.) to *Phœnicopsis*.

The specimens illustrated here belong to the Rajmahal series and are different from the Jabalpur and the Madras species. They were collected by the author from Sakrigalighat, about 1 mile north of Sakrigali railway station in the Rajmahal Hills, Behar. The specimens occur in a bed of much weathered and fragile shale, associated with genera like *Cladophlebis*, *Dictyozamites*, *Ptilophyllum*, *Pterophyllum*, *Tæniopteris* and *Elatocladus*.

Description.—Fig. 1 shows a fan-shaped leaf



FIGS. 1-3

deeply incised into five cuneate and somewhat linear segments. The upper part of the leaf is not preserved. The leaf-base tapers insensibly into a fairly stout petiole. The veins in the middle part of segments are about

0.5 mm. apart and are in places clearly seen to be dichotomous. Fig. 2 shows another leaf divided into four main segments, each of which is again partially divided into two lobes. The venation is not well preserved, but it seems to be similar to that of the first specimen. The leaf base appears to taper into a petiole, but the petiole itself is not preserved.

The specimen in Fig. 3 is bigger than the other two and possesses a petiole. The veins here are about 1 mm. apart and are seen to fork frequently.

Comparisons.—All the Rajmahal specimens differ from Feistmantel's *Ginkgo lobata* and *G. crassipes* in the division of the lamina into distinct segments. In the figure of *G. lobata* given by Feistmantel (loc. cit., pl. 1, fig. 1) the leaf may be segmented, but the specimen is too fragmentary for this feature to be made out with certainty. The present specimens are similar to Feistmantel's species in the dichotomous nature of the veins and in possessing a petiole.

Among other Gondwana forms, our specimens are comparable to *Ginkgo digitata* described by Walkom⁴ from the Ipswich series of Queensland. In the Rajmahal specimens, however, there is no prominent median cleft dividing the leaf into two main lobes. The veins are dichotomous in both and are placed at about the same distance apart. The specimens of *G. digitata* from other parts of the world show considerable variation in the division of the lamina, showing that the number of segments and the degree of their incision is not constant in this species.

The Rajmahal specimens may also be compared in their linear segments (Figs. 1 & 2) to *Ginkgoites sibirica*. A leaf of this species figured by Walkom⁵ from Queensland does not show any petiole; it is similar to our Fig. 2 in the deep incision of the lamina, but the subdivision of the third order in the segments is not seen in the Rajmahal specimens.

The Rajmahal leaves are being referred to *Ginkgoites* rather than to *Baiera* because the subdivision of the lamina is an uncertain character. It is met with in the young leaves of modern *Ginkgo* and in several species of *Ginkgoites*. Moreover, in the typical specimens of *Baiera* the segments are generally greater in number and more linear than in our specimens. The presence of petiole (Harris⁶) also is a character in favour of placing our specimens in *Ginkgoites*. The three fossil leaves from Sakri-galighat probably represent more than one species. But owing to the fragmentary nature

of the material no specific names are being given for the present. The specimens are of interest as there is no published record of the occurrence of Ginkgoes in the Rajmahal series.

Birbal Sahni Inst. SATISH CHANDRA DAS SAH.

of Palaeobotany,
53, University Road,
Lucknow,
March 5, 1952.

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3. —, *Pal. Indica Ser. II*, 1879, 1, (4), Pl. 15, fig. 6-9, 31-32.
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USE OF LIGHT OF DIFFERENT INTENSITY AND COLOUR IN LURING FISH

JAPANESE fishermen have developed methods of luring fish by using artificial light.^{1,2,3} Typical of these are the "stick-held dip-net", "set-net" and "purse-seine-net" fishing. In these operations they use electric bulbs of 150-500 watts power. Though the principle underlying the process is known in India, no attempt has hitherto been made to study the various aspects of the problem on a scientific basis.

Many types of "Chinese balanced-dip-nets" are being used for fishing in the backwaters of Travancore-Cochin State. During dark nights, these nets are operated with lantern or petromax light for luring fish. These "China nets" have been made use of in the present investigations to study the effect of light of different intensity and colour in attracting different species of fish and prawns.

Regular collection of fish at definite intervals was made from these nets during the various seasons, with the following lighting arrangements: (a) Lantern: 14 c.p.; (b) Sealed beam reflector: 6 v., 15 w., white, green, blue and red colours; (c) Petromax: 200 c.p., white, green, blue and red colours; (d) Electric bulbs: 230 v., 60 w., 100 w., 200 w., and 300 w. in white, green, blue and red colours.

Using the same net the average catch for each colour and intensity was compared with the value for a 14 candle power lantern as standard. Care has been taken to maintain uniformity in the timing of dips and in assessing the

catch each time. This comparative study was conducted in all the three lakes, viz., Ashtamudi, Kayamkulam and Vembanad under varying ecological conditions.

Our observations are as follows:

- (1) There is a definite increase, ranging from 200-600% in the total fish catch with the increase in the intensity of light used, up to a maximum of 200 watts, after which the catch decreases.
- (2) Green, blue and red-coloured lights were more effective than white light in attracting fish and prawns, the green colour being most effective.
- (3) With coloured lights, the bulk of the prawn catch generally consists of large specimens of *Penaeus indicus* (10-17 cm.), whereas with white light smaller specimens (3-6 cm.) predominate.
- (4) The following species have been found to be attracted: *Mugil*, *Hemiramphus*, *Caranx*, *Arius*, *Equula*, *Stolephorus*, *Chalæssus*, *Brachirus*, *Cuttle fish*, *Penaeus*, *Palæmon*, *Scylla* and *Nep-tunus*.

Fisheries Res. Station,
Kayamkulam,
Central Res. Institute,
Travancore University,
January 22, 1952.

C. V. KURIEN.
V. K. PILLAI.
G. S. NAIR.

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THE GENERAL PROPERTIES OF IRON OXIDE SOL

ONE of the most puzzling facts in the case of iron oxide sol, is the apparent variations in the properties of the sol and the contradictory conclusions arrived at even by experienced workers. Thus Judd and Sorum¹ report that iron oxide sols when sufficiently purified obey Burton and Bishop Rule. N. R. Dhar² considers that even with the highly purified sols containing a very small amount of chloride, the amount of electrolyte required for coagulation is greater, the greater the concentration of the sol, irrespective of the valency of the coagulating ion. However, Sorum³ maintains that the sols prepared by him were much purer and therefore his results are correct in respect of the sols prepared by him.

During our investigations connected with membrane equilibrium and conductivity, iron

oxide sols dialysed to different extents were prepared. It was found, in agreement with Judd and Sorum, that only highly dialysed sols have a tendency to obey Burton and Bishop Rule. As dialysis proceeded, the concentration of the attached gegenions per gram of iron oxide, decreased and the gegenions consisted predominantly of ferric ions, e.g., in a partially dialysed sol used in the membrane equilibrium experiment the total gegenions were about 0.307 m.e. of fixed hydrogen ions, and 0.599 of ferric ions, while in comparatively highly dialysed sols used in the conductivity experiment, the corresponding values were 0.068 and 0.2781. In the case of Sorum sols which were very highly dialysed, it is possible that the attached gegenions may consist almost wholly of ferric ions, while in the case of the sol prepared by Dhar, the attached gegenions may be predominantly hydrogen ions. Thus the two sols exhibit different behaviour with regard to the effect of dilution, because they are essentially different in nature.

Further experiments are in progress and the detailed account will be published elsewhere.

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December 12, 1951.

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STUDY OF A GROUP OF SYNTHETIC 3-METHYL ISO-QUINOLINES FOR THEIR SPASMOLYTIC PROPERTIES

PAPAVERINE has been in use for its relaxor effect on smooth muscles. This effect was attributed to its benzyl isoquinoline group. Several derivatives of papaverine have been synthesised. In most of these compounds there is a methyl group in the 3-position. Of these compounds 3-methyl-6,7-methylene-dioxy-1,3-pyridyl-isoquinoline is claimed to be a good substitute for papaverine. It has been noticed that the 3-methyl-isoquinoline compounds, as a rule, are less toxic than the 3-unsubstituted analogues. We had occasion to study a number of 3-substituted isoquinolines synthesised by B. R. Pai (of the Presidency College, Madras) for their spasmolytic property. Seven compounds were prepared and their chemical structures are given below:

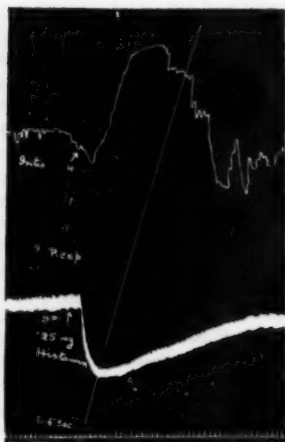


FIG. 1

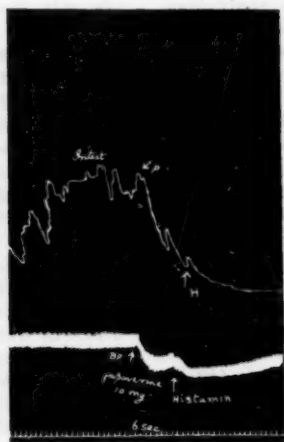


FIG. 2

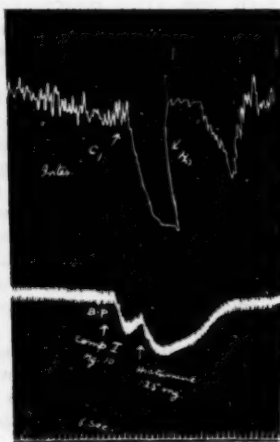
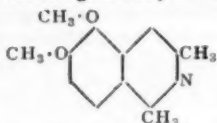
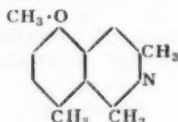


FIG. 3

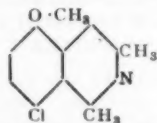
Record of Blood Pressure and Intestinal movements in a dog to illustrate (1) the spasmogenic property with .25 mg. of histamine; (2) the annulling effect of 10 mg. of Papaverine with .25 mg. of histamine; (3) the annulling effect of 10 mg. of Compound I with .25 mg. of histamine.



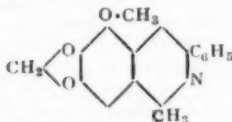
I: 1,3-dimethyl-5,6-dimethoxy isoquinoline.



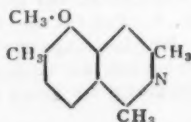
II: 1,3,8-trimethyl-5-methoxy isoquinoline.



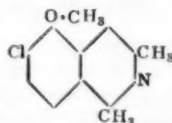
III: 1,3-dimethyl-5-methoxy-8-chloro isoquinoline.



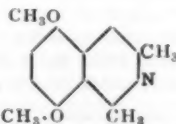
IV: 1-methyl-3-phenyl-5-methoxy-6,7-methylene dioxy isoquinoline.



V: 1,3,6-trimethyl-5-methoxy isoquinoline.



VI: 1,3-dimethyl-5-methoxy-6-chloro isoquinoline.



VII: 1,3-dimethyl-5,8-dimethoxy isoquinoline.

The experiments were performed on dogs. Histamine was used to produce spasm, as it is known that most spasmolytics exert their action better when a state of spasm exists rather than on normal smooth muscle. Intestinal movements were recorded with the aid of Jackson's enterograph. The object of our study was (1) to observe the action of these synthetic compounds in counteracting the spasm induced by histamine on the intestines and (2) to compare their potency with papaverine. It was found that 10 mg. of papaverine was able to counteract the effect of 0.25 mg. of histamine; an attempt was then made to compare the potency of the synthetic compounds, under our study, with papaverine.

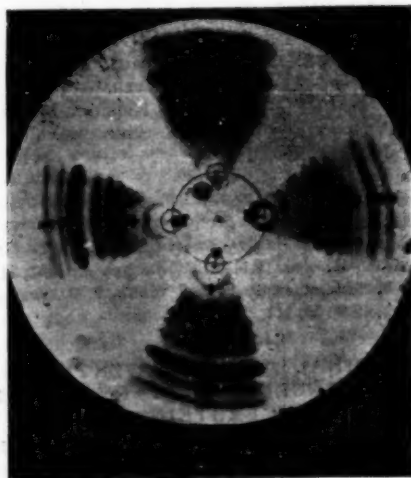
Compound I, dose per dose, compares favourably with papaverine. Compounds II to VI had no effect on the intestinal tone. Compound VII in the same doses as Compound I was able to relieve the spasm of the intestine, produced by histamine, partially. Higher doses could

not be tried as the quantity supplied was not sufficient. The examined compounds were thus not superior to papaverine in spasmolytic property though Compound I was as effective as papaverine.

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CIRCULAR PAPER CHROMATOGRAPHIC ANALYSIS OF THE AMINO ACIDS OF TEA AND COFFEE INFUSIONS

THE circular paper chromatographic technique¹ recently developed in our laboratories has been applied to the separation and identification of amino acids present in tea and coffee infusions. The extract was prepared by adding 50 c.c. of boiling water to 5 gm. of the material and filtering after about 30 minutes. The filtrate was spotted before and after hydrolysis with 6 N HCl. The chromatogram illustrated in the figure shows ten arcs well separated from each other, each containing one or more amino acids. The strongest arc (No. 7) in the chromatogram



Circular paper chromatogram showing the separation of amino acids present in tea infusion.

T—tea infusion without any treatment.

HT—tea infusion after hydrolysis with 6 N HCl.

ET—tea infusion after ether extraction.

which occupies a position very near to tyrosine is probably the mono ester of glutamic acid,

provisionally identified by Consden and Gordon² and Roberts and Wood³ in the juice of fresh and withered tea leaves. By running several mixed circular chromatograms¹ with known amino acids simultaneously with tea extract and by iono-phoresis and specific tests the presence of aspartic acid, glutamic acid, leucine (and iso-leucine), phenyl-alanine, valine, alanine, serine, asparagine, tyrosine, arginine, histidine, lysine and proline have been identified in tea infusion. The presence of other amino acids reported by Roberts and Wood³ have not been identified with assurance by us.

The identity of arc No. 7 as a mono ester glutamic acid was established by the following tests:

- (1) On acid hydrolysis of the tea infusion, the intensity of this arc (No. 7) decreases considerably with simultaneous increase in the intensity of the arc No. 5 relating to glutamic acid and very slight increase in the intensity of arc No. 4 relating to aspartic acid, without altering the intensity of other arcs. This indicates that the substance is of the nature of an ester of glutamic acid. The increase in intensity of the arc No. 4 on acid hydrolysis is due to the conversion of asparagine into aspartic acid.
- (2) On subjecting the tea infusion to iono-phoresis and running a mixed chromatogram of the solutions contained in the cathode, anode and central chambers, it was found that the substance producing arc No. 7 was present only in the central chamber.

It is interesting to note that coffee infusion was found to contain very insignificant amounts of amino acids compared to tea infusion.

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DEAMINATION OF AMINO ACIDS BY *VIBRIO CHOLERA*

STUDY of the enzymic make-up and metabolism of vibrios may throw some light on the pathogenicity of *Vibrio cholerae* and also the inter-relationship, if any, among the various types of vibrios. Very little attention seems to have been paid so far to this aspect. A systematic study of the endo- and exo-cellular enzymes of *Vibrio cholerae* has therefore been undertaken. Since deamination¹ is the normal metabolic process by which micro-organisms growing in an alkaline environment utilise the amino acids of the medium, the deaminases have been studied first.

Deamination by cholera vibrios was studied by the technique of Stephenson and Gale.² Twenty-four-hour growth of the organism on agar slopes (pH 8.0) was harvested with 0.85% sodium chloride solution and, after centrifuging, washed once with saline and re-centrifuged. The residue was suspended in saline and adjusted to a turbidity equivalent of 40% transmission in a Lumetron Model 'A' Photoelectric colorimeter, using Red filter 650 m μ . 1 ml. of suspension was shaken for one hour at 38° C. with 1 ml. of 3 M/250 amino acid and 1 ml. of phosphate buffer of appropriate pH value. The ammonia liberated into the reaction mixture was estimated by direct nesslerization, keeping adequate controls for the turbidity produced by the cells. Results of some typical experiments on a few amino acids are reported as Q_N in the following Table:

TABLE I
Deaminase activity of different strains of vibrios.
Activity expressed as Q_N * for 1 ml. suspension.

No.	Organism	Amino acid					
		Aspartic acid pH 8.0	Glycine pH 7.5	Glutamic acid pH 7.5	Lysine pH 7.0	Serine pH 7.0	
1	49514 Ogawa	27.2	4.0	..	..	7.3	
2	123 ..	16.0	8.0	..	..	34.4	
3	122 ..	55.5	12.8	7.5	5.3	27.0	
4	132 ..	67.0	12.8	12.2	7.4	23.5	
5	52 ..	79.0	9.6	12.2	7.4	20.8	
6	49514 Inaba	22.4	2.4	..	..	4.0	
7	123 ..	12.4	4.0	..	..	15.2	
8	119 ..	34.0	6.4	5.3	3.5	10.6	
9	113 ..	44.8	6.4	7.6	5.3	15.0	
10	74 ..	54.6	10.6	7.6	5.3	12.3	
11	49524 ..	56.5	10.6	6.4	2.1	18.1	
12	569B ..	67.2	5.3	4.3	2.1	12.3	

* Q_N = μ l of nitrogen calculated from the corresponding ammonia values.

The results (Table I) show that *Vibrio cholerae* possess deaminases in their enzyme make-up and the rate of deamination varies from amino acid to amino acid and from one strain to another. Among the amino acids studied, arginine, aspartic acid, glycine, glutamic acid, lysine, serine and threonine were deaminated. Aspartic acid and serine showed maximum activity. Activity on alanine, phenylalanine, leucine, histidine, methionine, tyrosine, tryptophane and valine was negligible. Deamination was found to be strictly aerobic as would be expected from the fact that the organism itself is highly aerobic. The optimum pH of action was in the range of 7-8 for the amino acids studied. Various factors influencing the activity of deaminases and the relation of the former to the enzymes responsible for synthesising amino acids in vibrios are under investigation.

The interesting feature observed in these studies was that, in general, the Ogawa subtypes showed higher deaminase activity than the Inabas, and this is clear from the differences between the activities of the Ogawa strains 123 and 49514 and the Inaba sub-types derived from them.³ This aspect of the change of enzyme activity during the transformation of Ogawa into the Inaba sub-type is under further study.

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INTESTINAL THIAMINE SYNTHESIS AS INFLUENCED BY DIETARY LEVELS OF PROTEIN

RECENTLY, bacterial synthesis of vitamins in the intestinal tract of the animal host, has received considerable attention.^{1,2,3} The intestinal flora seem to be modified by the ingredients of the diet. While the effects of carbohydrate,⁴⁻⁶ fat⁷ and minerals⁸ on the intestinal synthesis of vitamin B₁ have been fairly well investigated, the role of protein in influencing the synthesis has not been systematically studied. Our experimental observations in re-

gard to the effect of different dietary protein levels on the intestinal synthesis of thiamine are presented and discussed in this communication.

Three groups of young albino rats (weighing from 40-50 gm.), each consisting of 6 animals, were depleted of their body stores of thiamine by giving them a thiamine-free diet for 3 weeks, when visible symptoms of thiamine deficiency were observed. They were then given 5, 15 and 40 per cent. respectively of vitamin-free casein incorporated in a diet which consisted, in addition to the protein, of maize starch, coconut oil at 10 per cent. level and McCollum and Davis' salt mixture. All the vitamins of the B group, except B₁ and vitamins A and D were supplied in adequate amounts to the rats and the experimental procedure followed that described in earlier experiments of the authors.⁹ The average values for the thiamine excretions and storage levels of thiamine (per animal) are presented in Table I.

TABLE I

% Protein in diet	Total weekly excretion of Thiamine		Total body stores of thiamine at the end of the experi- ment in γ
	In urine γ	In faeces (dry basis) γ	
5	0.31 \pm 0.0012	0.37 \pm 0.001	0.11 \pm 0.0007
15	0.16 \pm 0.0014	0.20 \pm 0.0004	0.10 \pm 0.0004
40	0.15 \pm 0.0002	0.24 \pm 0.0008	0.08 \pm 0.0001

The results indicate an increased excretion of thiamine by the group of rats fed 5 per cent. casein, as compared with the other two groups receiving higher percentages of casein.* That the increased excretion cannot be due to a greater depletion of the body stores in this group of rats is borne out by the results on the body stores of all the three groups of rats at the end of the experiment. It would therefore appear that the higher excretion by the low casein group of rats is due to increased intestinal synthesis.

We are indebted to Prof. K. V. Giri and Dr. S. S. De for their kind help during the investigation.

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February 1, 1952.

* It may be mentioned here that one rat on 40% casein diet and two animals on 15% casein diet, died

during the last week of the experiment and that there was no mortality in the 5% casein group of rats which were fairly healthy.

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INFLUENCE OF DIETARY SUPPLEMENTATION OF MILK AND CURD ON THE INTESTINAL SYNTHESIS OF THIAMINE IN RATS

THE types of bacteria developing in the intestines and helping the animal host in synthesizing vitamins seem to be pronouncedly modified by the nature of the diet.^{1,2} It was therefore felt desirable to study the nature of bacteria that develop in the intestines and the effect of these on the synthesis of thiamine when milk and curd are included in the diet. Our experimental observations are recorded in this communication.

Three groups of young albino rats (weighing from 40-60 g.) six in each, were given a basal diet (consisting of vitamin free casein, maize starch, coconut oil, and salt mixture) free from thiamine. The control group was given 3 γ of pure vitamin B₁ (in solution) per rat per day. Group A rats were supplied the same amount of vitamin B₁ through 8.5 c.c. of milk and group B rats through 8 g. of curd.* All the other B-complex vitamins and Adexolin were supplied to the rats in adequate amounts.† After a preliminary feeding for 3 weeks, 2 separate weekly urinary and faecal collections were made and analyses of the weekly urinary and faecal thiamine excretions were carried out employing the thiochrome procedures (using Lumetron Fluorimeter) described by Mawson and Thompson³ and 'Methods of Vitamin Assay' by the Association of Vitamin Chemists-1947 respectively.

At the end of this metabolism period, 3 rats from each group were killed and their total thiamine stores were analysed by the thiochrome method of Greenberg and Rinehart.⁴

On a different set of rats, consisting of 3 animals in each group, and maintained on the same dietary factors, the faeces were collected

under aseptic conditions and examined for total count, coliform and lacto-bacilli organisms. The results (average) are presented in Tables I and II.

TABLE I

Group	Total weekly excretion of thiamine		Body stores of thiamine γ	Net increase in weight g§
	In urine γ	In faeces (dry basis) γ		
Milk ..	0.42±0.0015	1.69±0.022	0.41±0.0009	22.3
Curd ..	0.66±0.0015	2.76±0.25	0.51±0.0002	33.7
Pure vitamin	0.46±0.0015	1.79±0.018	0.45±0.0001	21.7

§ during the five-week period.

TABLE II

Group	Total no. per gram of faeces of		
	Bacteria × 10 ⁶	Coliform organisms × 10 ⁴	Lactobacilli × 10 ⁶
Milk ..	9	10	9
Curd ..	31	111	8.3
Pure vitamin	21	31	6

The results (Table I) show that the excretion of thiamine by the rats receiving curd in their diet is higher than in the other two groups. The status of the body stores of thiamine in the 3 groups of rats would serve to eliminate the possibility of greater depletion of the Vitamin B₁ in the curd-fed rats. The possibility that the higher excretion in the curd group may be due to poor absorption of the vitamin B₁ is ruled out by comparison of the growth rate of rats, of the three groups, curd group rats showing the greatest increase in body weight. It would thus seem quite possible that the increased excretion of thiamine by the latter is due to increased intestinal synthesis.

The above consideration is further substantiated by the bacteriological data (Table II). It may be seen that the total count as well as the number of coliform organisms are highest in curd group rats.

Our observations in regard to the type of pre-pondering bacteria are in close confirmation with those of the early workers,^{7,8} in that feeding of milk has led to the establishment of lactobacilli.

The authors wish to thank Prof. K. V. Giri and Dr. S. S. De for their keen interest and Dr. M. Sirsi for his kind co-operation in the bacteriological part of the investigation.

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* Vitamins B₁ and B₂ in 6 milk samples and corresponding curd samples were estimated by the methods of Harris and Wang⁴ and Kodicek and Wang⁵ respectively. The additional amount of riboflavin supplied by curd was added to the diets of the milk and control group rats.

† Each rat received daily the following amounts of vitamins.—50 γ of riboflavin, 50 γ of calcium pantothenate, 10 γ of nicotinic acid, 10 γ of pyridoxine and 1 mg. of choline. Each rat was given two drops of adexoline twice a week.

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LEAF SHAPE EXPRESSION IN NEW WORLD COTTON HYBRIDS BETWEEN WILD DIPLOIDS AND CULTIVATED TETRAPLOIDS

STEPHENS² furnished adequate data in support of his hypothesis that the leaf-shape continued to change from node to node until the commencement of flowering phase which put a stop to such variations from the stage of the climax leaf production. The hypothesis, however, did not come out true in the case of hexaploids and triploids produced through crossing wild and cultivated American cotton varieties.

Work on the synthesis of new tetraploids through crossing American wild diploids with cultivated tetraploids was undertaken in 1944 at Coimbatore, mainly with the object of developing fertile types resistant to drought, jassids and blackarm. Diploid *G. raimondii* was used as a parent for effecting crosses with *G. hirsutum* (Coimbatore type 4463) and *G. barbadense*

(Sea Island type V 135). The sterile triploid (*G. raimondii* × *G. hirsutum*) was doubled with colchicine to produce fertile hexaploid which in turn was crossed with cultivated Americans for obtaining new tetraploids. The leaf-shape development in the triploids and hexaploids was very characteristic in the fruiting branches and different from the normal behaviour recorded in *Gossypium* so far. The main changes noticed in the parents, the triploids and the hexaploid are illustrated in the Plate. The hypothesis fitted *in toto* when applied to the three parents, viz., *G. hirsutum*, *G. barbadense* (not included in Plate) and *G. raimondii* but not to the tri-

mondii was apparent from the increase in measurement 'L' (length of the median lobe from centre of Callus spot to tip) and reduction in 'W' (maximum width of median lobe).

In the examples cited by Stephens¹ to demonstrate the dominance resulting from threshold effects, the ultimate phenotypic expression of alleles was shown to depend upon two variables, viz., (a) dosage—controlled by allele, (b) the rate of leaf-development—controlled by genotypic background. The pattern occurrence of entire leaf in flowering branches at all nodes in triploids and at particular flower-bearing nodes in hexaploid might be viewed as having resulted from the timing action of alleles due to the threshold effects of dominant wild gene present in *G. raimondii*. The phenomenon points to a very definite evolutionary trend which is not clear at the moment.

The author's thanks are due to Sri. V. Santanam for the pen and ink drawings.

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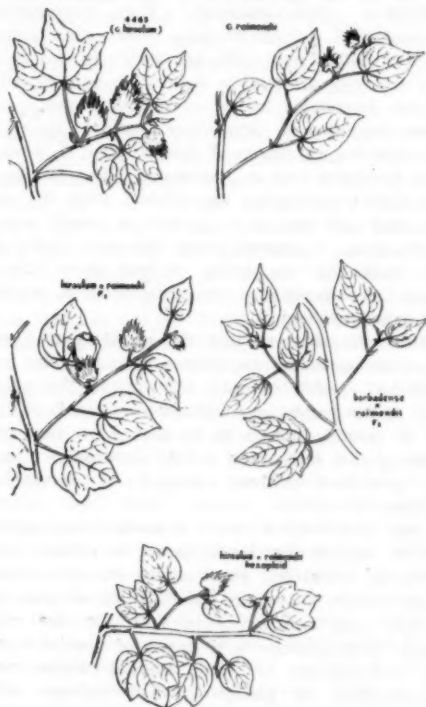
STABILITY OF VITAMIN C IN NEERA FROM DATE PALM AT 37° C. (*Phoenix sylvestris*)

No preservative was added to these samples. The vitamin C content was estimated by the titrimetric method with 2:6 dichlorophenol indophenol¹. The results obtained with 2 samples, the one giving the lowest and the other giving the highest values for vitamin C, together with the effect of storage, are given in Table I.

TABLE I

Sample	mg. vit. C/ 100 c.c. neera	
	I	II
Original sample ..	7.14	12.5
Stored at 37° c. for		
24 hrs. ..	7.13	12.08
48 hrs. ..	7.04	12.03
72 hrs. ..	6.96	11.92
8 days ..	6.88	11.72
15 days ..	6.84	11.52

ploid crosses and hexaploids. The leaves on the fruiting branches of the triploids were mostly entire like *raimondii*, the lobed leaf of the tetraploid parent being located on the main stem node subtending the branches. In the hexaploid on the other hand, the entire lobed leaf occurred only at the nodes of the secondary fruiting branches carrying flower buds but not at other nodes. The influence of gene *L*² in the shape expression of entire leaves in the triploid between *G. barbadense* and *G. rai-*



It is clear from the above that vitamin C in neera is remarkably stable on storage for even 15 days at the end of which period, more than 90 per cent. of the vitamin is retained. It might be mentioned here that during storage, the pH of neera changed from 7.5 to 3 as a result of fermentation. The stability of vitamin C could not be ascribed to the fall in pH as was shown by incubating pure vitamin C at pH 3 for 15 days, which showed a marked deterioration under our experimental conditions.

The stability of vitamin C in neera may however be ascribed to the presence of SH compounds, as these compounds are known to protect vitamin C from oxidation.² The different neera samples all gave a very strongly positive reaction with nitroprusside. The amounts of SH compounds were then quantitatively estimated by iodimetric titration after making necessary correction for the vitamin C content as determined by the indophenol titration. The different neera samples were found to contain from 89 mg to 175 mg of the SH compound per 100 c.c. Further, storage at 37° C. for 72 hrs. had no marked effect on the concentration of SH compounds. Ascorbic acid reductase was also found to be present in the neera samples as detected by Crooks' method.³ Neera was also found to have marked inhibitory action on ascorbic acid oxidase. Glutathione has been shown to work in conjunction with the reductase and keep vitamin C in a reduced form.⁴ Attempts are now being made to isolate glutathione from neera.

Our thanks are due to the Chief Neera Organizer and his colleagues for their kind co-operation.

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PADDY-CUM-FISH CULTURE IN RELATION TO PUBLIC HEALTH

In an earlier review¹ of the Indonesian practices of combined cultivation of rice and fish attention was directed to the fact that in these practices, besides a catch crop of fish, there is also an increased yield of paddy by about 5 to

10%. Both these commodities are needed for improving the nutrition of the people in rice-growing areas. It has often been feared by Public Health authorities that such paddy fields may encourage the breeding of undesirable species of mosquitoes thus endangering public health. Dr. A. E. Hofstede,² Inland Fisheries Adviser, Djakarta (Indonesia), has partly met this objection by producing some experimental evidence.

The investigation carried on in the plain of Tjiandiyur by Hofstede related to the rate of development of mosquitoes, particularly malaria vectors, in rice fields where fish and rice are cultivated simultaneously. The experiment showed that during 90 days, when the transplanted paddy had sufficient water in the field and fish were growing in association with it, only a few *Anopheles* larvæ were found and even these belonged to non-vector species, such as *A. subpictus*, *A. vagus*, *A. barbirostris*, *A. annularis hercanus* and *A. hercanus*. After 90 days, the paddy vegetation was closed, with the result that full and heavy growth of weeds, especially grass, appeared along the inner sides of the banks of rice fields. It was then that a mass development of the dangerous *A. aconitus* was observed.

Hofstede observes that the experiment "confirms the practical experience of more than one fisheries expert, namely, that up to the 'closing' of the paddy vegetation no serious breeding of *A. aconitus* needs to be feared, so that fish rearing as a catch crop among growing rice may be practised without danger of increasing malaria".

The above is a very important conclusion which should be investigated in other rice-growing countries, particularly in such situations where there are possibilities of growing a fish crop simultaneously with the rice crop. Such investigations will prove of special value in 24-Parganas of West Bengal where vast possibilities of paddy-cum-fish culture exist already. Growing of fish in paddy fields may thus confer an additional benefit by controlling the breeding of mosquitoes and thereby reducing the incidence of malaria.

Museum House,
Calcutta-13,
March 26, 1952.

S. L. HORA.

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**PROLONGED LARVAL PERIOD AND
DELAYED EMERGENCE OF ADULTS IN
PROCONTARINIA MATTEIANA KIEFF.
& CECC. (ITONIDIDAE : DIPTERA)**

UNUSUAL prolongation of the larval life is known to occur in many insect species.^{1,2,3} The present author, in his studies on the mango leaf gall midge, *Procontarinia matteiana*, observed a similar prolongation of the larval period and subsequent delayed emergence of the adults in several successive batches.

P. matteiana has three broods in a year. The first flight is in March and is composed of adults from the overwintering larvae of the different broods of the previous year, in various proportions. The larvae of the first generation have a very wide developmental period. Some develop quicker and produce adults in July while in others the larval stage is prolonged considerably and the adults emerge in October or even in March of the following year. The second flight, which is in July, is also a composite one and is made up partially of adults from the larvae of the previous year's second and third broods and partially of adults from the first generation larvae of the same year. The larvae of the second generation too, like the first, do not all develop equally and while some may be well developed and produce flies in October, the others continue as such till March or July of the year following. The third is in October with flies coming mainly from the first and second generation larvae of the same year. The third generation larvae overwinter and produce the first batch of adults in March next when general emergence of flies takes place from the overwintering larvae of the various broods of the previous year. There is some evidence to show that although most of the remaining galled leaves are destroyed at the time of leaf fall in March, some containing larvae of the second and third generations survive from which the flies emerge in July. Not more than two emergences have so far been observed from the larvae of the third generation.

The larval period in *P. matteiana* may thus be prolonged from about two months to almost a complete year in the larvae of the same batch from the eggs laid at the same time and with emergence of adults occurring regularly in two or three batches. It may be worth while mentioning that *P. matteiana* oviposits in tender leaves only and the three flights of the year coincide with the three main periods when the new mango leaves unfold in these parts. The larvae of different broods are, therefore, present in leaves of different ages.

The exact causes which bring about this very wide fluctuation in the larval period of *P. matteiana*, under the same conditions, have not yet been studied, but the resultant partial and rhythmic emergence of adults, which coincides with new leaf emergence, appears to be a device to overcome the disadvantages inherent in the species. In the first place the duration of the adult life, in which the fly has to complete the oviposition, is only about 48 hours, and secondly, the oviposition, is restricted to the tendermost leaves. Further studies are in progress.

I am grateful to Dr. K. B. Lal for helpful guidance.

Lab. of the Entomologist R. L. GUPTA.
to Government,
Uttar Pradesh,
Kanpur,
December 20, 1951.

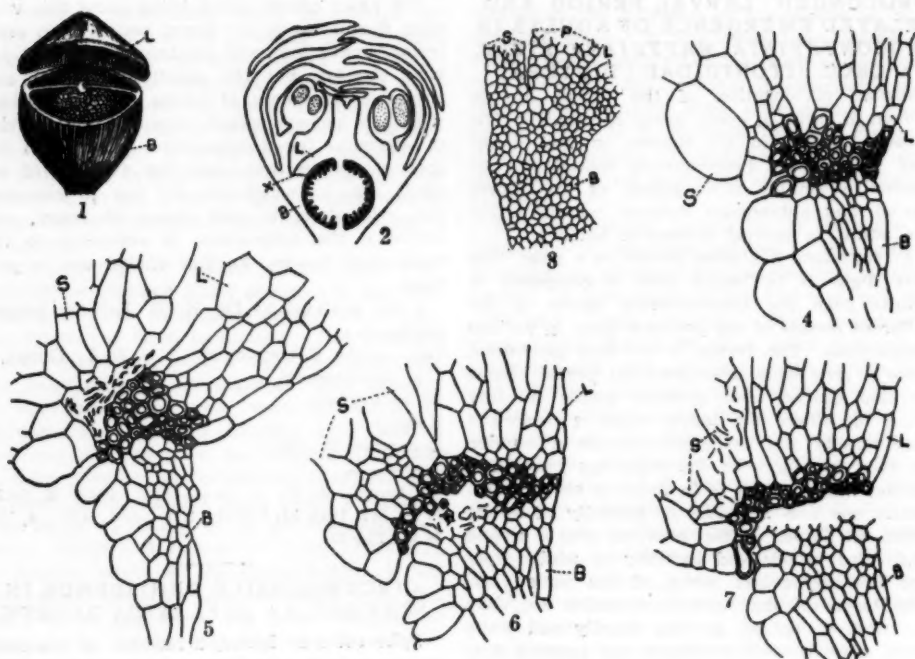
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**CIRCUMSCISSILE DEHISCENCE IN
SPHENOCLEA ZEYLANICA GAERTN.**

Sphenoclea zeylanica, a member of the Campanulaceae (Sphenocleaceae, according to Airy Shaw¹), has a fruit of the nature of a pyxidium (Fig. 1). The ovary is semi-inferior and bilocular with an indefinite number of ovules borne on axile placentae. The upper portion of the ovary wall is free and this corresponds to the future lid (Fig. 2, L). The lower portion of the ovary wall which is fused with the remaining basal parts of the flower, forms the base (B) of the fruit.

The wall of the young ovary is made up of ten to fourteen layers of uniform thin-walled parenchymatous cells (Fig. 3). At a later stage, however, the inner cells in the lower region or the base, gradually disorganize so that it becomes narrower. In the mature fruit the lid comes off in a circumscissile manner from the base, at the region marked X in Fig. 2. In this region a group of transversely arranged cells gradually become lignified. The extent of the lignified cells is shown in Figs. 4 and 5.

In a fairly old fruit, at a stage when the dicotyledonous embryo is organised in the seed, some of the thin parenchymatous cells in the upper portion of the base and lying immediately below the group of lignified cells, show gradual signs of degeneration (Fig. 6). This degeneration extends to either side (Fig. 7) with the result that the lid gets detached from the base



FIGS. 1 to 7

FIG. 1. Mature pyxidium; FIG. 2. L.S. young flower bud, $\times 20$; FIG. 3. L.S. left side of young ovary wall, $\times 100$; FIGS. 4 and 5. Stages in the organization of lignified cells, $\times 135$; FIGS. 6 and 7. Stages showing the gradual degeneration of cells of the base lying immediately below the group of lignified cells, $\times 135$. B = Base; L = Lid; P = Petal; S = Sepal. in a circumscissile manner all round (Fig. 1). Finally, the lid drops off exposing a large number of brownish black seeds in the centre of the base (Fig. 1). The opening of the lid may also be due at least partially to the pressure exerted by the enlarging seeds.

Recently, the anatomy of circumscissile dehiscence has been described in *Hyoscyamus niger*, *Portulaca grandiflora*, *Plantago major*, *P. maritima* and *P. pusilla* by Rethke³ and in *Anagallis pumila* by Raju². The mechanism of dehiscence in these forms, however, is slightly different from that described in the present form. The final stage of dehiscence in *Sphenoclea zeylanica* approaches closely the condition described by Rethke³ for *Hyoscyamus niger*. But in *Hyoscyamus niger* the ovary is superior and its inner and outer epidermal layers become heavily lignified.

Our sincere thanks are due to Prof. P. Maheshwari for valuable suggestions, and Prof. L. N. Rao for encouragement.

Dept. of Botany,
Central College,
Bangalore 1.
April 7, 1952.

K. SUBRAMANYAM
M. V. S. RAJU.

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ABNORMAL LEAVES OF *CYCAS REVOLUTA* THUNB.

CERTAIN abnormal rachises in cultivated female specimens of *Cycas revoluta* which form the topic of the present investigation were found to be remotely similar to those described by Le Goc.¹ Serial sections were cut to study the disposition of tissues.

The abnormal rachis showed an upper folding of tissues and differentiation of a 'subsidiary rachis'. This was formed mainly by the bulging and pronounced development of the

upper bract-like portion of the principal rachis. Subsidiary leaflets were arranged in a spiral manner in contrast to the opposite arrangement of the normal leaflets (Fig. 1).

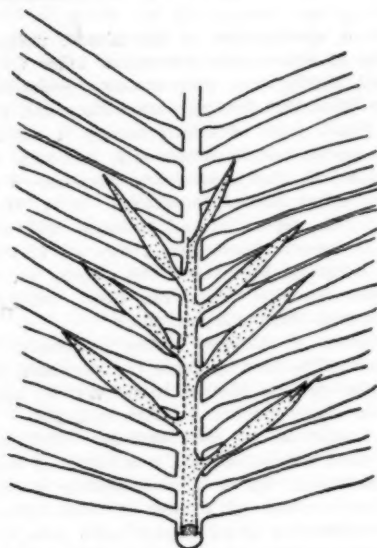


FIG. 1. *Cycas revoluta* Thunb. Upper portion of an abnormal leaf to show the subsidiary rachis (dotted) and subsidiary leaflets (dotted).

The subsidiary leaflets were formed by a

gradual process of elongation and constriction. The differentiation of a transfusion tissue served to hasten the formation of leaflets. The supply of leaflets was also formed by a division of the bundle of the subsidiary rachis. The xylem of the foliar bundle showed a clear mesarch condition.

The total length of the subsidiary rachis did not exceed 7 cm in the several specimens examined and the subsidiary leaflet was usually 3.0 cm in length.

The organisation of the subsidiary leaflet was similar to that of the normal leaflet but tissues were condensed to fit in a far smaller space.

Goebel's² contention that 'the pinnules in the middle region of the leaf appear before the upper and under ones', appears to be confirmed by this study.

My sincere thanks are due to Professor Shri. Ranjan for encouragement and laboratory facilities. To Mr. G. P. Agarwal and Mr. B. B. S. Raizada, I am grateful for help in the preparation of sections.

Botany Dept., RAMESH KUMAR SRIVASTAVA,
University of Allahabad,
Allahabad,

January 25, 1952.

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FORTHCOMING INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCES

Date	Subject of Conference	Organised by	Location
July 4-6	.. Joint Commission on high Altitude Research Stations, I.C.S.U.	Secretary, Dr. R. Stämfli, Bülhplatz 5, Berne, Switzerland	Denver, Colorado
July 7-11	.. Symposium Evolution	Dr. R. Brown, Society for Experimental Biology, Botany Department, Leeds University, Leeds	Oxford
July 9-14	.. 6th International Congress of Animal Husbandry	Secretariat, European Association for Animal Production, c/o Ministry of Agriculture, Copenhagen	Copenhagen
July 14-19	.. International Congress of Physical Medicine	Hon. Secretary, Dr. A. C. Boyle, 99, Harley St., London, W. 1	London
August 11-21	.. International Scientific Radio Union—General Assembly	Secretary, Mon. Eng. E. Herbays, International Scientific Radio Union, 42, rue des Minimes, Bruxelles	Sydney, Australia
Sept. 1-3	.. 3rd International Spectroscopy Colloquium	Secretary, E. Van Someren, Industrial Spectroscopy Group of the Institute of Physics, 47, Belgrave Square, London, S.W. 1	London
Oct. 24-25	.. Symposium on Chemical-Biological Co-ordination	The Secretary, Chemical-Biological Co-ordination Center of the National Research Council, 2101, Constitution Avenue, Washington, D.C.	Washington, D.C.

REVIEWS

Astrophysics. (*A Topical Symposium*). Edited by J. H. Hynek. Astronomical Series. (McGraw Hill), 1951. Pp. 703. Price \$12.00.

The book under review is a commemoration volume planned on the occasion of the fiftieth anniversary of the famous Yerkes Observatory of the University of Chicago (founded in 1897), and is in the nature of a topical symposium of 14 papers presented by outstanding workers reviewing the progress in the active branches of astrophysics during the past 50 years.

The Editor's aim has been "to address a hypothetical first year graduate student well versed in fundamentals but by no means a specialist". The subject-matter is divided into four sections: (i) Spectroscopic astrophysics; (ii) The Physics of the Solar System; (iii) The Physics of Binary and Variable Stars; and (iv) The Physics of Cosmic Matter. The book opens with an "Introduction" by Bengt Ström-gren, giving a brief account of the astrophysical ideas prevalent about the beginning of this century. This forms an appropriate background against which the growth of knowledge during the past five decades can be viewed in its proper perspective.

The first five chapters covering more than a third of the book are devoted to Spectroscopic Astrophysics. A short account of the classification of stellar spectra and its physical significance by P. C. Keenan and W. W. Morgan is followed by a fairly detailed and lucid exposition of the interpretation of normal stellar spectra by Lawrence W. Aller. In the next chapter Otto Struve deals with the analysis of peculiar stellar spectra, a field in which he has done pioneering work. An excellent survey of the role played by molecules in the spectra of astronomical bodies by P. Swings contains a long list of problems of an experimental and theoretical nature awaiting solution. The last and longest chapter of this section is the masterly survey by Bengt Ström-gren of 'The Growth of Our Knowledge of the Physics of the Stars' during the present century.

The second part of the book deals with 'The Sun and Stellar Radiation' (Edison Pettit), 'Comets' (N. T. Bobrovnikoff) and 'On the Origin of Planets' (Gerhard P. Kuiper). Kuiper's conclusion that "the present developments indicate that the process of planetary formation

is but a special case of the almost universal process of binary star formation" sums up the present status of a long-standing problem.

The third part dealing with Binary and Variable Stars, both of which occupy a place of great importance in Astronomy, has four contributors. G. Van Biesbroeck discusses 'Visual Binaries and Stellar Parallaxes', J. A. Hynek deals with 'Spectroscopic Binaries and Stars with Composite Spectra' and Newton L. Pierce with 'Eclipsing Binaries'. The chapter on 'The Intrinsic Variable Stars' has been contributed by Cecelia Payne-Gaposhkin.

'Physics of Cosmic Matter' contains two chapters. The first by Jesse L. Greenstein deals with 'Interstellar Matter' in its various aspects and its significance in stellar evolution. The last chapter of the book entitled: 'The Structure, the Composition, and the Source of Energy of the Stars' by S. Chandrasekhar gives an excellent survey of a field of astrophysics in which advances in knowledge have come largely from the theoretical side.

The reviewer feels that the inclusion of selected photographs of stellar spectra in Chapter I, illustrating the significance of the spectral sequence would have been valuable. Again, Chapter 6 dealing with the sun could have been amplified to give a more detailed account of those aspects of the physics of the sun which are either just touched upon or not referred to at all. There is, for instance, no mention of the Evershed Effect in sunspots.

The beginner in the field of astrophysics finds that there are few books which suit his requirements. The majority of books available are either too popular or too specialised. The book under review bridges this gap. The careful reader will find almost every chapter stimulating and thought-provoking. It is indeed a very valuable addition to astrophysical literature.

R. ANANTHAKRISHNAN.

Laboratory Instruments: Their Design and Application. By A. Elliott, Ph.D., and J. Home Dickson. (Chapman & Hall Ltd., London), 1951. Pp. 414. Price 32 sh. net.

The book is intended to provide in a concise form relevant information useful to workers

for the design and fabrication of experimental set-ups and instruments. The book is prefaced by a descriptive statement of the factors which influence the design of measuring instruments in general. The intelligent reader is expected to work out for himself the details of any particular design in which he is interested, in the light of the information provided.

The book can be conveniently divided into two parts. The first part consisting of eleven chapters deals with general design principles together with the kinematics of design. The first chapter discusses the accuracy of machining operations indicating the tolerances obtainable with specific tools. The second chapter deals briefly with the properties of various types of wood, steel, alloy steels, copper and aluminium alloys and after summarising the various properties in a table goes over to the consideration of plastic materials and materials for springs. A useful table on the strength of silica fibres is provided. The third and the fourth chapters give a brief account of the fundamentals of workshop practices like casting and welding of metals, information on screws and rivets and the preparation of drawings for the workshop. The fifth is a good chapter on the kinematics of constraints and couplings. The sixth chapter deals with the methods available for the measurement of small displacements and refers briefly to Tolansky's work on multiple beam interferometry. Sensitivity of instruments and systematic and other errors are considered in a general manner in the next chapter while the eighth chapter deals pretty exhaustively with the methods for producing vibrationless supports. An account of the recent work of Haringx on the design of antivibration mountings is given in this chapter for a body having one degree of freedom. A chapter on damping of instruments followed by one on the tests for flatness, straightness and squareness concludes the first half of the book dealing with mechanical design.

The second part, which consists of five chapters but comprises more than half of the volume, is devoted to the properties of glass, the working of glass, lenses, mirrors and prisms, description of optical instruments and finally photography in research. Ray tracing methods are indicated in an appendix and references to literature are given for the benefit of those who require further details. The chapters on properties of glass and the methods of working glass are exceptionally complete and contain many useful practical hints, tables, charts and

diagrams. The chapters on lenses, mirrors and prisms and optical instruments are also exhaustive with copious illustrations and tables, but at the same time clear and concise. The chapter on photography is brief in comparison, but deals with many useful topics, especially optical filters.

The discussions in the book are mainly physical without going into the details of actual design. Selected references are given at the end of each chapter for further reading, many of which are quite recent. As a whole, this book will be of great help to scientists in India who are usually handicapped by inadequate training in the design and construction of instruments. As most of the data compiled in this book are usually scattered in journals and manufacturers' catalogues, this book with its clear, logical and precise style and absence of unnecessary details would certainly go a long way in indicating the principles on which a good design can be based and help in appreciating the limitations of the instrument so designed. Throughout the book, discussions are interspersed with extremely useful and interesting practical details from the authors' experience.

A discussion on the merits and demerits of dark room safe lights used in the processing of photographic films and plates should have been added in order to make the chapter on photography sufficiently complete. The reviewer also feels that presentation of some information on ferromagnetic alloys and their working and the design of high vacuum equipments would have added to the value of the book.

The book is well indexed and well illustrated and the printing and binding are excellent. The price, however, appears to be a little too high.

D. L. BHATTACHARYA.

The Magnetron. By R. Latham, A. H. King and L. Rushforth with a Foreword by L. J. Davies. (Chapman & Hall, London), 1952. Pp. x + 142. Price 18 sh. net.

This book is written by persons who took part in the development and manufacture of the magnetron. The book is divided into fourteen chapters. The basic idea of the radar, V.H.F. oscillators, the development of the multi-resonator magnetrons, properties of the anode block, extraction of energy from the magnetron, the electronic theory, cathodes, constructional technique and manufacture performance testing and application of magnetron to radar come

up for separate treatment. There are valuable references to original literature. There is a good name and subject-index.

Every chapter is most lucidly written and it is indeed a delight to read through the book. The subject-matter is quite authentic and so selected as to cover the fundamental ideas clearly and completely. The printing and get-up is excellent. The diagrams and photographs are aptly chosen. In brief, the authors have succeeded in treating this important and fascinating subject completely in the short space of 142 pages. The price (18 sh.) is not high considering the value of the work.

The book will serve as a text to all students of electrical and communication engineering and Honours students in physics. Also, it will be a useful addition to every engineering and science college library.

S. V. CHANDRASEKHAR AIYA.

The Lipids: Their Chemistry and Biochemistry. Vol. I: Chemistry. By Harry J. Deuel Jr. (Interscience Publishers Inc., New York), 1951. Pp. xxiv + 982. Price \$ 18.50.

This book is the first of two volumes on lipids dealing with their chemistry only; volume II is to concern exclusively with biochemical and nutritional aspects. Earlier monographs relate only to certain of the components included under the general classification of lipids; Hilditch's recent treatise on "The chemical constitution of natural fats" (1947) is an example. Prof. Deuel has now made a comprehensive survey of present knowledge concerning the chemistry of all lipid-like compounds associated with animal and plant tissues; emphasis has been on those of animal origin. The work is also "intentionally slanted" from the point of view of a biologist.

The volume comprises ten chapters the first five of which are devoted to simple and conjugate lipids while the rest deal with vitamins belonging to the class of derived lipids. Chapter I commences with definitions and classification of lipids. Chapter II deals with the chemistry of fatty acids and glycerol. The chemistry of neutral fats is discussed in Chapter III. Chapter IV describes waxes, higher alcohols including sterols, triterpenes, glyceryl ethers, coloured fats and hydrocarbons. Chapter V presents the chemistry of the biologically important group of compounds: phosphatides and cerebroside.

The treatment in each chapter includes classification and nomenclature, distribution

and properties, composition and synthesis. The chapter on glycerides outlines critically the various theories that have been advanced to explain the glyceride composition of fats and oils.

The latter five chapters of the monograph give an extensive account respectively of the carotenoids and related compounds, vitamins A, provitamins and vitamins D, vitamins E and vitamins K. Among the various topics that have been dealt are those relating to occurrence, chemistry, structures, properties including spectral, stereochemical and chromatographic behaviour, optical rotation and solubility. A noteworthy feature of the chapter on vitamin A is an account of twelve known syntheses of the vitamin and related compounds.

Each one of the chapters represents a careful and thorough evaluation of the progress in the subject covering almost the entire literature. The practical methods for synthesis, separation, purification and analysis are described to the extent necessary for a complete understanding of the subject. A feature of the book is the discussion of all lipid-like materials in animal tissues. Among the interesting biological problems dealt with may be mentioned those dealing with toxicity of synthetic fats, structure of fatty acids as related to antileprosy action and chemical structure in relation to biological activity of vitamins E, K and like compounds.

The treatise is throughout extensively supported by references to literature and profusely illustrated with graphs, tables and photographs. In addition to the usual author and subject indices, a special section is devoted to generic names of plant and animal sources from which lipids are derived. The volume constitutes an invaluable reference book to all concerned with the study of this wide group of substances.

A. SREENIVASAN.

Sugar Industry in India and Abroad. By Prasanna Chandra Goswamy, Cotton College, Gauhati, 1951, Pp. 72. Price Rs. 3.

In view of the recent history of sugar manufacture and distribution in India, some salient and highly significant facts brought out by this pamphlet deserve serious thought by both by the industrialists and the government.

India has been the original home of the sugarcane, but sugar is dearer in India than in England and U.S.A. where it costs only 5 d. a pound and 9.75 cents respectively.

The factories have made huge profits throughout these years but most of them have not modernised their equipment or introduced new techniques to improve efficiency of production.

Despite agricultural research, the yield of cane has not improved, the average having remained all these years at 14 tons per acre in India, as against 65 tons in Hawaii, 56 tons in Java and 41 tons in Peru. One reason for this lies in the location of farms in the least climatically suitable regions for sugarcane cultivation like U. P. and Bihar which have the largest acreage, and possess 106 factories, while the more suitable regions like Bombay and Madras have lower acreage and possess only 31 factories. The logical step would be to extend sugarcane cultivation in the latter region where the yield is 2 to 3 times that in U. P. This has not yet been taken up in earnest. The author advocates Assam and Bengal, too, as regions suitable for establishing more factories. India needs to produce over at least three million tons of sugar in addition to the present production of gur. This can be done only if the acreage of sugarcane is increased in the Deccan. For this purpose, the first essential is that irrigation facilities have to be gradually but quickly extended.

In the interests of all concerned, sugarcane prices must be reduced to normal levels and imports of sugar, too, allowed in order to bring down sugar prices. Also, Indian manufacturers should be encouraged to manufacture all the equipment needed within the next ten years.

The author makes valuable suggestions to bring Indian technical and agricultural efficiency on a par with foreign practice, and eminently deserves to be congratulated for compiling this thought-provoking booklet.

Y. K. RAGHUNATHA RAO.

Studies on the Natural Fats. By A. R. S. Kartha. (Published by the Author, Department of Chemistry, Maharaja's College, Ernakulum), 1951. Vol. I, Parts I-II. Pp. 143. Price Rs. 5. Vol. II, Part IV, Pp. 111. Price Rs. 2.

After a critical appraisal of well-established methods of analysis, the author describes modified methods of his own for the determination of the glyceride structure of fats. Analytical data on some 26 fats examined by him are given. The author then questions several well-known theories such as Hilditch's rule of 'even distribution' enunciates hypotheses of his own to the effect that fatty acid formation is governed almost entirely by their heat content and that unsaturated acids are synthesised

to a large extent for their "fluidising" purposes, applies same to various fields of metabolism like seed fats and milk fats and evolves interesting theories of his own. In Volume II, Part IV, he further develops his theory of "fluidisation", discusses the mechanism of formation of depot fats and provides explanations for various physiological phenomena connected with fat metabolism.

The new theories are no doubt attractive and worth serious consideration by others. But it is felt that a less dogmatic presentation would have enhanced their value a great deal.

Also, due to the reading matter being strung together without proper spacing, the use of too many abbreviations, and poor printing, the volumes prove none too easy reading. They certainly deserve better printing and publishing.

S. A. S.

Facts, Files and Action in Business and Public Affairs. (Part I, *Sources and Backgrounds of Facts*). By J. Edwin Holmstrom. (M/s. Chapman & Hall), 1951. Pp. xvi + 449. Price 36 sh. net.

The book under review is the first of a series of three intended by the author to assist the planner and the man of business 'in the art of getting things done'. As the comprehensive title indicates, Part I is in the nature of a source book, covering a wide range of subjects and giving under each heading, in engagingly essay form, broad outlines of the subject for the easy comprehension of the non-specialist in the field.

The subjects have been arranged alphabetically, while the reference numbers start afresh on each page. This has the double advantage of avoiding footnotes and enabling the Bibliography given at the end to be used also in reverse.

The volume would indeed serve as an excellent model to any who wish to compile a similar one on Indian Institutions as comprehensively and yet as compactly, as the author has been able to achieve, with special reference to British Institutions.

Science in the School Garden. By Mary A. Johnstone. (Macmillan & Co. Ltd., London), 1951. Pp. xiv + 176. Price 4 sh. 6 d.

Miss Johnstone's well-illustrated and excellently-produced little volume is addressed to the children of primary schools and lower forms of secondary schools in England, and succeeds

eminently in its object of enabling young minds to look at the phenomena happening in and around a school garden with a scientific habit of mind. Objective account of the structure, growth and function of living and non-living things are skilfully interwoven with the author's personal observations so as to produce just the right tone which, as children, we have all learnt to love. The book can be heartily recommended to the young ones in our country who have learnt to think and feel in English.

Physical Properties of Some Samples of Asbestos-Cement Siding. By Cyrus C. Fishburn. U.S. Dept. of Commerce. Building Materials and Structures Report 122.

The pamphlet has five sections, of which the first two are general in character. The third section deals with standard tests on specimens. The tests include different methods of measuring the thickness, linear expansion on exposure to high pressure steam, linear change in wetting and drying water absorption, flexural strength and extensibility under flexural load including strength, extensibility and modulus of elasticity. Section four deals with the standard tests conducted by the British Building Research Board which include (i) Flexbire tests, (ii) Tensile tests, (iii) Impact tests, (iv) water absorption, and (v) moisture movement. Effect of natural weathering and accelerated weathering is also dealt with including the effect of acid rain water and action of frost.

Section five draws general conclusions, highly instructive to practical engineers.

K. SEETHARAMIAH.

The Dynamics of Faulting and Dyke Formation with Applications to Britain. By F. M. Anderson. Second Edition. Revised: (Oliver & Boyd, Edinburgh & London), 1951. Pp. x + 206. Price 22 sh. 6d. net.

Dr. E. M. Anderson is a rare example of a geologist who attempts to interpret geological phenomena from the physical point of view. He has interested himself for nearly fifty years in the dynamics of faulting, and sheet intrusion, and of the formation of cone-sheets, ring-dykes and caldron subsidences. The book under review was first published in 1942, and this edition went out of print in 1947. The present issue is the second revised edition, and contains some additional material.

After briefly sketching the history of research in this branch of tectonics, he discusses the dynamics of faulting under three

types: thrust faults, wrench faults, and normal faults. The dynamics of dyke formation is next considered. A rapid survey is then made of some of the more important fractures, fracture systems and dyke swarms in Britain.

The chapter dealing with faults and recent earthquakes is of great interest. Considerable work has been done in Britain, especially by Dr. Davison, in compiling a list of historical earthquakes, and this has been used by Dr. Anderson for making a comparison of the seismological and tectonic data. The close connection between faults and earthquakes is brought out by the fact that out of the 820 earthquakes which originated in Scotland, about 700 were connected with three main lines of fracture—the Great Glen Fault, the Highland Boundary Fault and the Ochil Fault. The relationship is, however, not so clear in England and Wales, though several shocks can be connected with known or inferred faults. A brief reference is made to "earth-shakes" which occur in mining districts and which possess the characteristics of shallow earthquakes.

The author finally deals with crustal dynamic problems such as uniformity of stress, vertical pressure in crust, superposition of stresses, wedging effect of sheet intrusion, strength of crustal materials, alteration of stress due to faulting, and the thermal effects of earthquakes.

The book is well printed on good paper, and is illustrated by 39 text-figures. The value of the book is enhanced by the bibliography given at the end of each chapter, and by the index.

Workers in the field of tectonics from all over the world will find this book highly stimulating and instructive.

C. S. PICHAMUTHU.

Chemical and Electro-Plated Finishes. By H. Silman. Second Edition. Revised. (Chapman & Hall Ltd., London), 1952. Pp. xiv + 479. Price 50 sh.

The book in its second edition goes a long way in fulfilling the need for a comprehensive treatise on the protective treatment of metals by chemical and electroplating methods.

The subject-matter is divided into fourteen chapters: Chapter I deals briefly with corrosion and the characteristic properties under corroding conditions of the important metals used in industry. The next 3 chapters are devoted to the preparation of the metal prior to finishing: descaling and pickling, polishing, degreasing and cleaning. The subject has been dealt with exhaustively, as it should be; the

types of equipment employed in industrial practice have been well described as also the essential theory. Chapter V covers the various methods for the colour finishing of metals.

The modern plant and equipment for electroplating, including automatic plant, has been described in detail in the next chapter. Chapters VII to XII deal with the electrodeposition of the important metals and alloys. A good attempt has been made to include as much of useful and up-to-date information as possible. The next Chapter is devoted to the finishing of aluminium, magnesium and their alloys: anodising, immersion treatment and electroplating. The information given is useful from the practical view-point. The last chapter gives a brief account of the different methods for the testing of finishes. Each chapter contains a list of references, although not exhaustive, and the book is profusely illustrated with diagrams, photographs, figures and tables.

The author has throughout kept in view the modern trends and industrial applications of finishing. The book will no doubt be useful to the student as well as the industrial finisher and plater. It is well written and can be regarded as a valuable contribution to the metal finishing field.

T. L. R.

A Coloured Atlas of some Vertebrates from Ceylon, Vol. I, Fishes. By P. E. P. Deraniyagala. Ceylon National Museums Publication, (Government Press), 1952. Pp. i-xi + 149. Plates I-XXXIV. Text Figs. 1-60.

This lovely publication is principally an album of coloured plates of the more common fishes of Ceylon. All the strictly freshwater fishes of the island as well as representatives of a few marine families are illustrated along with brief accounts of the more common genera and species. Taxonomic keys for identification and notes on distinctive features of the species are given. The work should appeal to every category of reader from the specialist to the layman. The Ceylon reader will also be pleased to get information on the places where he may look for the various forms mentioned and illustrated. It is natural that a work of this type cannot be exhaustive, but there is sufficient material in the text for the serious investigator dealing with Indo-Pacific fishes which is a field of study offering scope for much further exploration. There are many

well-known marine fishes of the Indo-Ceylon coasts which the reader will miss. This volume will be widely welcomed owing to the paucity of popular and at the same time scientifically accurate accounts of fishes inhabiting tropical waters.

The thirty-four colour plates (as well as the 60 text-figures), all done by the author, provide the most attractive feature of the book; the illustrations have been well reproduced. The Ceylon National Museums is to be congratulated for the publication of the present volume which is the first of a series on Vertebrates of Ceylon, and the first volume on fishes by the Director now published would set a high and worthy standard. The publication of the succeeding volumes will be awaited with interest.

N. K. P.

Books Received

Transmitting Valves (The Use of Pentodes, Tetrodes and Triodes in Transmitter Circuits). Electronic Valves, Book VII. By J. P. Heyboer & P. Zijlstra. (Philips Technical Library), 1951. Pp. xii + 284. Price not given.

Application of the Electronic Valve in Radio Receivers and Amplifiers, Vol. II (Electronic Valves, Book V). By B. G. Dammer, J. Haantjes, J. Otte and H. Van Suchtelen. (M/s. Philips Technical Library), 1951. Pp. xviii + 431. Price not given.

Merck Index of Chemicals and Drugs, 6th Edition. (M/s. Merck & Co.), 1952. Pp. xiv + 1,162. Price \$ 7.50.

Adhesives for Wood, Vol. III. By R. A. G. Knight, (M/s. Chapman & Hall), 1952. Pp. xi + 242. Price 25 sh.

The Terpenes, Vol. III. (Second Edition). By Sir John Simonsen and D. H. R. Barton, (Cambridge University Press), 1952. Pp. xi + 579. Price 50 sh.

Rasayana Sastra (Madhyamika), Marathi (Second Edition). By M. B. Pande. (Vignana Prakasana, Nagpur-2), 1952. Pp. 303. Price Rs. 3.

Science German Course. By C. W. Paget Moffatt. (Oxford University Press), 1952. Pp. vii + 325. Price Rs. 7-12-0.

Trigonometry, Plane and Spherical. By Lloyd L. Small. (McGraw Hill Book Co.), 1952. Pp. xii + 406. Price \$ 3.75.

SCIENCE NOTES AND NEWS

S. A. Hill Memorial Prize

The S. A. Hill Memorial Prize for the most outstanding research work done in the Allahabad University during 1950-51 has been awarded to Sri. S. N. Tewari for his work on "Hydrous Oxide of Chromium and Aluminium".

Electrified Glass

A process which keeps the windscreens of aircraft free from ice and snow has been developed at the NPL, England. It consists in coating glass with a thin transparent film which will conduct electricity. The film can be heated by passing a current of electricity through it. Visibility through the glass is reduced by a negligible extent, while enough current can be passed through it to keep it from steaming over in cold weather.

Research Information Service

A large number of recent patent applications by German manufacturers dealing with the manufacture and processing of textile auxiliaries are now available in English translation in the form of *Bulletins* by Research Information Service, the well-known publishers and translators of scientific papers and patent literature. The *Bulletins* may be had free of charge by writing to Research Information Service, 53 Nassau Street, New York 38, N.Y.

Award of Research Degree

On the recommendation of a Board of Examiners consisting of Dr. S. S. Guha Sircar, Prof. M. C. Nath, and Dr. D. Chakravarti, the degree of Ph.D. of the Utkal University was conferred on Sri. Mahendra Kumar Rout, Cuttack, for his thesis "Preparation and Bactericidal Properties of Some Organic Mercury Compounds".

Synthesis of Morphine

Details of the research work leading to the synthesis of morphine were reported recently by Marshall Gates and Gilg Tschudi of the University of Rochester, U.S.A.

Morphine is the principal alkaloid of opium and was first isolated in 1905. The complex structure of the drug was finally defined accurately in 1925. But up until now, all attempts to synthesise it had been unsuccessful. The process starts with Schaeffer's acid, a dye derived from coal tar, and twenty seven steps are taken to convert it into morphine. Syn-

thesis of codeine is an intermediate step in the process.

Helminthological Society of India

The following Office-bearers of the Society were elected for the year 1952:

President:—Dr. G. S. Thapar, *Vice-Presidents*:—Dr. M. B. Lal and Dr. B. S. Chauhan, *Secretary*:—Dr. Kr. Suresh Singh (Department of Zoology Lucknow University), *Treasurer*:—Dr. J. Dayal, *Foreign Secretary*:—Dr. S. L. Hora, *Other Members*:—Dr. L. N. Johri, Dr. Anantharaman and Shri K. N. Gupta.

Dr. W. W. Cort, of Johns Hopkins University, Baltimore, U.S.A., was elected Honorary Fellow of the Society.

Associateship Examination: Institution of Chemists (India)

The Second Examination for admission to the Associateship will be held in November 1952. The last date for receiving applications from the intending candidates is 31st July 1952. The examination in Group A (Analytical Chemistry) is divided into the following nine Sections, and the candidate will be examined in any three of them according to his choice.

(1) Analysis of Minerals, Silicates, Ores and Alloys; (2) Analysis of Drugs and Pharmaceuticals; (3) Analysis of Foods; (4) Analysis of Water and Sewage; (5) Biochemical Analysis; (6) Analysis of Oils, Fats and Soaps; (7) Fuel and Gas Analysis; (8) Analysis of Soils and Fertilisers; and (9) Analysis Connected with Forensic Chemistry.

Further enquiries may be made to the Honorary Secretaries, The Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Free Supply of World Fisheries Abstract

Any fisheries technologist who has had difficulties in obtaining FAO's *World Fisheries Abstracts* in the past, may hereafter acquire his subscription free in exchange for technical information. The procedure is to write to the F.A.O. Vialle delle Terme di Caracalla, Rome, Italy, expressing interest and willingness to contribute to FAO information on special subjects which may be asked for from time to time, for incorporation in the work of the FAO, its document and publications. This exchange arrangement will not, however, affect normal subscription.